Department of Pharmacology
The University of Melbourne
1953–1995

BY

NATALIE KORSZNIAK

Professor Frank Herbert Shaw (*ca* 1946).

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Preface

'To understand a community you must first know its history'

It is in this context that I asked Dr Catherine Laska to research material for the preparation of a history of the Department of Pharmacology at the University of Melbourne. My hope is that the progressive community of scholars and staff can learn the history and understand 'the place' and 'its people' and take the discipline of Pharmacology forward with purpose and pride as the University motto states:

'To grow in the esteem of future generations!'

I would like to thank Dr Natalie Korszniak for her thoughtful and perceptive work in making this project happen, and all the past staff, friends and scholars who have contributed their recollections so willingly.

Professor James A. Angus
August, 1996

Introduction

In 1950 when the idea of a Department of Pharmacology was first mooted by the University of Melbourne, the study of pharmacology was rapidly developing in both America and Europe. The knowledge to be gained from *pharmacological* studies was considered to be of significance to many other biomedical academic fields, as well as being of prime importance for the pharmaceutical industry. In Australia, particularly, it was felt that there existed enormous opportunities for the development of therapeutic agents based on substances isolated from the unique flora of the country. Additionally, it was felt that knowledge of drugs and hormones could benefit the agricultural industry in Australia, with improvements in plant growth and pest control.

Many of these views were based on very early research projects conducted by staff members of the Department of Physiology, including a screen of various Australian plants for any pharmacologically active substances. Although that particular study did not yield any fruitful results and was not pursued, the new Department of Pharmacology, in its first 10 years, was responsible for the development of several new, clinically useful drugs that were subsequently used world-wide. As the Department matured, the research focus changed, and later contributions made by members of the department to international pharmacology included significant developments of the knowledge of prejunctional receptor systems, as well as the publication of an authoritative pharmacology textbook used by students of pharmacology world-wide.

The primary function of any University department is the dual responsibility of research and teaching of under- and post-graduate students. The Department of Pharmacology has been involved in the teaching of pharmacology to medical, dental and science students. Over the years the various courses have evolved, in part to meet the changing needs of practising professionals. Significant changes have included the expansion of

both the medical and dental pharmacology courses, the introduction of the pharmacology course for physiotherapy students and the division of the science course from two very broad teaching units for third year students into four specialized teaching units, a specific second year teaching unit for second year science students and a separate pharmacology course for optometry students.

The aim of this book is to trace the development of the Department of Pharmacology, from its origins in the Department of Physiology until December 1995 and to record significant contributions made by various individuals within the department to teaching and research in pharmacology. Given the enormous technological advances presently being made, it is perhaps also timely to review their impact on both the current teaching practices and research directions in pharmacology and to speculate on what the future may hold in store for the Department of Pharmacology at the University of Melbourne.

Establishment of a Chair of Pharmacology

In 1939 Roy Douglas Wright succeeded as Professor of Physiology at the University of Melbourne. Shortly after, Wright submitted a report to the Medical Faculty noting what he saw as the 'gross deficiencies' of his new department. Wright felt that the Department of Physiology lacked teaching staff, laboratory apparatus and that the laboratory accommodation was less than adequate. He submitted a request to the Medical Faculty for money to equip and to alter the laboratories and lecture theatre, and for extra staff, including a full-time lecturer in Pharmacology. The Medical Faculty granted his requests and in 1940 Frank Herbert Shaw was appointed as the University's first full-time lecturer in Pharmacology. In 1947 Shaw was promoted to Associate Professor (Pharmacology) within the Department of Physiology.[a]

It was not until early 1953 that a concerted effort was made by Wright to establish a separate Chair of Pharmacology within the University. Earlier

recommendations (circa 1950) made to the University Council by the Professorial Board indicated that, funds permitting, it would be desirable to establish several new Chairs within the University, including a Chair of Pharmacology. However, as always, funds were difficult to obtain and so little was done to pursue the matter further.

In April 1953 the University of California extended the offer of the Chair of Pharmacology to Shaw. Shaw had proven himself to be a valuable member of the research staff of the Department of Physiology, and Wright was loathe to lose him overseas. To prevent Shaw's departure, Wright undertook an intensive campaign to lobby the University to establish a Chair of Pharmacology. The then Vice-Chancellor of the University, Professor G. W. Paton, agreed that a Chair of Pharmacology could be established provided that a sum of £1500 could be secured to fund the Chair from outside sources. Wright then undertook an extensive campaign to enlist financial support for the new Chair from various pharmaceutical companies. His success was astonishing. By June 1953 Wright had secured the promise of £1800 *per annum* for at least five years from six local companies, including Nicholas Pty Ltd and Sigma Co. Ltd (refer to Table 1).

Table 1 External funding sources for the foundation Chair of Pharmacology, University of Melbourne (1953)*

Company	Amount pledged (£)
Nicholas Pty Ltd	500
Sigma Co. Ltd	500
Burroughs Wellcome & Co.	250
Imperial Chemical Industries	200
Woods Pty Ltd	200
Fawns & McAllen Pty Ltd	150
Total	1800

* Information was obtained from the University of Melbourne Archives, R. D. Wright papers.

In August of 1953, the University Council approved the recommendation of the Standing Committee on the Chair of Pharmacology (which had been convened to investigate the matter) that the Chair be established. On December 21, 1953, the University Council ratified Frank Herbert Shaw's appointment as the first Professor and Chairman of the Department of Pharmacology at the University of Melbourne. He took up his appointment on January 1, 1954.

Professors of Pharmacology, 1954–95

The University mandate specifies that the Professor of Pharmacology is required to teach and to stimulate research work within the department (refer to Appendix I). Over the period 1954–95, the pharmacology teaching course has been expanded and staff are now involved in teaching pharmacology to 200 medical, 180 second year science, 45 third year science, 40 optometry, 60 dental and 80 physiotherapy students in the faculties of Science and Medicine, Dentistry and Health Sciences. The focus of research work performed by departmental staff over the same period has changed dramatically and has tended to reflect the personal philosophies and research interests of the incumbent Professor of Pharmacology. The three men who have so far been appointed to the Chair of Pharmacology at the University of Melbourne have all come to the Department with distinguished research careers. In the case of Professors Shaw and Rand, these men, in their time as professor, have put their own indelible mark on the department and have guided their staff to make notable achievements in the field of pharmacological research. It is of interest then to trace the development of their own research concerns prior to their appointment as Professor of Pharmacology.

Frank Herbert Shaw, Professor of Pharmacology 1954–1964

Frank Herbert Shaw was born in Melbourne in 1910. He was educated at Scotch College, and graduated from the University of Melbourne in 1933 with a BSc(Hons) degree majoring in Physiology and Biochemistry. He was given a supplementary award of £30 in 1933 for his work on the 'Effect of ethylene on enzymes and the effect of fungoid growth on oranges'. Following further study under Professor Young in the Department of Physiology, Shaw was awarded an MSc for his work on enzymes, which included studies into the action of ethylene in plants, and the occurrence, distribution and synthesis of acetylcholine in the body and its role in muscular action. He subsequently left for London in 1935 to take up a

position as a PhD student in the laboratory of Sir Charles Lovett-Evans and Professor J. H. Gaddum at the University College. While there, Shaw pursued research work into the chemistry of adrenaline and, along with Gaddum, developed a chromatographic method using alumina for the adsorption and subsequent elution of adrenaline that was the forerunner of the Anton and Sayre method, which is still used as an initial purification step in some catecholamine assays today. Shaw was awarded a PhD in 1938.

Shaw returned to Australia and to the Department of Physiology on a research scholarship circa 1940. As mentioned earlier, he was appointed Lecturer of Pharmacology in 1940 and in 1943 was made Senior Lecturer. He shared the Syme Prize in 1945 and was promoted to Associate Professor (Pharmacology) in 1947 within the Department of Physiology. In 1954, Shaw was made the first Professor of Pharmacology and Head of his own Department. The terms of his appointment are reproduced in Appendix I.

Shaw's early research interests in pharmacology were wide-ranging. In the early 1940s, whilst he was still a part of the Department of Physiology, Shaw elicited financial support from the then CSIR Division of Plant Industry for a pharmacological survey of Queensland rainforest plants. The focus of the survey was to identify plants containing alkaloid-like materials and to isolate and purify these compounds. It was hoped that alkaloids with either medicinal potential as anti-hypertensives, anaesthetics or sedatives, or potential as rabbit poisons could be found and developed for subsequent commercial use. Shaw was also aware of the contribution non-pharmacologists could make to this project and, after the end of the Second World War, he was responsible for recruiting many pure chemistry graduates into his pharmacological research group to carry on the plant survey project.

Shaw was also involved in other pharmacological research projects within the Department of Physiology. These projects included the investigation

of the role of calcium in smooth muscle contraction, of the significance of adrenaline and noradrenaline in blood pressure control and of the mechanisms of electrolyte control in frog skeletal muscle (a project undertaken in collaboration with Shirley Freeman and one which continued after the Chair of Pharmacology had been established).

Shaw's interest in excitatory/analeptic agents was stimulated in the late 1940s by the arrival of Geoff Bentley in the Department of Physiology as a research student. Bentley, at the time, was occupied with an investigation into the pharmacology of 5-aminoacridine and it was his observation that this compound could combat the respiratory depressant effects of morphine that caught Shaw's imagination. Shaw began an extensive research programme in the area of excitatory/analeptic agents that continued in the new Department of Pharmacology and led to the subsequent development of several drugs that were used clinically to combat unwanted CNS depression caused by various agents.

Shaw retired from the Chair of Pharmacology in 1964. His retirement, due to illness, had been preceded by a period of instability and uncertainty within the Department. As a result of his extended absence from the Department, Shirley Freeman was made acting Head from 1964 until the appointment of the new Chair at the end of 1965. Frank Shaw died in 1971.

Michael John Rand, Professor of Pharmacology 1965–92[b]

Michael Rand was appointed to the Chair of Pharmacology in November 1965. Rand, born in Suffolk, England, in 1927 came to the department with an outstanding record of achievement. He was educated at Ivanhoe Grammar School before completing his undergraduate studies at the University of Melbourne. He commenced an MSc with George Reid in the Department of Physiology in 1950. Together, Reid and Rand undertook extensive research into serotonin and were the first to publish an account

of its pharmacological actions.[c] It was the premature death of George Reid at the age of 37 from malignant hypertension that fuelled Rand's later interest in cardiovascular pharmacology.

Following the completion of his MSc studies, Rand enrolled in the Department of Pharmacology at the University of Sydney in 1953 for a PhD in pharmacology under the supervision of Roland Thorp.[b] He proceeded to Oxford in 1956 for post-doctoral studies with J. H. Burn and together they developed and explored the Burn–Rand hypothesis of the existence of a cholinergic link in noradrenergic transmission. Although the existence of such a link was eventually disproved, the hypothesis itself was a stimulus for a great deal of research that led to significant developments in the knowledge of neurotransmitter mechanisms.

After his time in Oxford, Rand returned briefly to Sydney in 1959 as an Australian and New Zealand Life Insurance Research Fellow to pursue his interest in cholinergic links in noradrenergic transmission. He returned to London in 1960 to take up a Wellcome Research Fellowship at the School of Pharmacy. While there, Rand met William C. Bowman and Geoff West with whom he would later write the *Textbook of Pharmacology*. Rand returned briefly to Australia on sabbatical leave from the School of Pharmacy in 1964 and returned permanently in 1965 to take up the Chair of Pharmacology at the University of Melbourne with an outstanding record of achievement.

At the time of his appointment the features of the Department were not dissimilar to those experienced by Wright after taking over the Department of Physiology in 1939. In Rand's own words 'the morale of the staff was at a low ebb, accommodation was squalid and unkempt, and the equipment was either obsolete or inadequate in quality'[b].

However, the problems regarding the accommodation of the department did not distract Rand from the task of establishing a high profile research and teaching department within the University of Melbourne. During his

time as Professor, Rand pursued his interest in noradrenergic pharmacology, as well as fostering the diverse research interests of other members of staff. Upon his retirement in December 1992, at the age of 65, the Department of Pharmacology at the University of Melbourne had a world-wide reputation for excellence in research in the areas of autopharmacology and had trained and nurtured many researchers who have since gone on to contribute significantly to the international research community.

Aware of the need of a new Head of Department to be given the opportunity to develop his own management style, Rand declined an offer to continue his research within the Department of Pharmacology after his retirement. Offers were also made by the departments of Physiology and Zoology, however, Rand moved to the Department of Medical Laboratory Science at the Royal Melbourne Institute of Technology following the appointment of Professor David Story to the Chair. Rand continues his research activities at RMIT.

During Rand's time as Professor of Pharmacology there were actually two other Heads of Department, namely Marion McCulloch (1982–84) and David Story (1986–92). After retiring, Rand was succeeded to the Chair of Pharmacology by James Angus, formerly the Deputy Director of the Baker Medical Research Institute at the Alfred Hospital in Prahran.

In addition to his commitment to the Department of Pharmacology, Rand has also made significant contributions to a number of national and international organizations.

Since 1968, Rand has had considerable involvement with the World Health Organization, sitting on the WHO Expert Advisory Panel on Food Safety, the Joint Expert Committee on Food Additives and Contaminants, the joint FAO/WHO/IAEA Committee on Wholesomeness of Irradiated Foods and the joint FAO/WHO Expert Consultation on Residues of Veterinary Drugs in Foods.

He has contributed locally by sitting on many extramural committees, such as the Addiction Research Institute, the Poisons Advisory Committee, the Proprietary Medicines Advisory Committee, the National Health and Medical Research Council and the National Heart Foundation.

Upon Rand's retirement from the University of Melbourne, the Australasian Society of Clinical and Experimental Pharmacologists and Toxicologists inaugurated the 'Rand Medal' in 1993 in recognition of his contributions to and achievements in pharmacology. The Rand Medal is awarded biennially to a member of ASCEPT whose research has been deemed to have made an outstanding contribution to clinical or experimental pharmacology or toxicology.

James Alexander Angus, Professor of Pharmacology 1993–

James Angus was born in Sydney in 1949 and was educated at Barker College, Hornsby, NSW. He studied pharmacology as a third year science student at the University of Sydney. Over the period 1969–73, Angus undertook Honours and PhD studies with Associate Professor Bruce Cobbin in the New Bosch Laboratories, which were run by Rand's former PhD supervisor, Professor Roland Thorp. During this time Angus developed a novel myocardial contractility index in conscious dogs while studying the haemodynamic effects of various inotropic agents. Later, as a post-doctoral fellow, Angus worked with Professor Paul Korner in the Hallstrom Institute of Cardiology at the Royal Prince Alfred Hospital in Sydney. There he investigated the Guyton theory of autoregulation as a cause of hypertension and studied the pharmacology of cardiovascular histamine receptors, before coming to Melbourne in 1975, with Korner, to the Baker Medical Research Institute.

In 1976 Angus took up a C. J. Martin Travelling Fellowship and spent 2 years in England where he worked, with Sir James Black FRS, first at University College London (1976) and then at the Wellcome Research Laboratories in Beckenham (1977). While in England, Angus developed

analytical methods for the determination of pK_B estimates of histamine H_2-receptor antagonists and confirmed the obligatory role of histamine as the final mediator of vagal stimulated acid secretion.

Angus returned to Australia and to the Baker Medical Research Institute in 1978. He established the Pharmacology Laboratory at the Institute and, over the next 4 years, recruited several key members of staff to form the basis of his own research group. The research interests of this group included investigations into the properties of EDRF, serotonin in vascular reactivity, the role of autoinhibitory feedback in cardiac neurotransmission and vascular reactivity in hypertension, atherosclerosis and heart failure.

Angus was awarded the Alfred Gottschalk Medal from the Australian Academy of Science for unravelling many properties of endothelium-dependent relaxing factor, now thought to be nitric oxide, in 1984. He was appointed Deputy Director of the Baker Medical Research Institute in 1990 and was given a personal Chair in Pharmacology by the Faculty of Medicine at Monash University in 1992. He was appointed to the Chair of Pharmacology at the University of Melbourne in 1993. His current research work links peptide chemistry, peptide NMR structure and various pharmacological assays in order to unravel the pharmacology of synthetic analogues of neuropeptide Y and the N-type calcium channel antagonist, conotoxin GVIA, isolated from the venom of the marine snail *Conus geographus.*

In addition to his own research and teaching commitments, Angus also contributed to the development of medical research in Australia by his participation in the activities of the National Health and Medical Research Council (NH&MRC) and by his membership of the Editorial Board of the Australian journal *Clinical and Experimental Pharmacology and Physiology*. In 1991, Angus was appointed Chairman of the NH&MRC Grants Committee and was a member of the MRC over the period 1991–93. In 1996 he was elected a Fellow of the Australian Academy of Science.

Endnotes

Information for this section was obtained from the University of Melbourne Archives (R. D. Wright Collection), the University of Melbourne Research Reports, *Who's Who Australia*, Professors Ivan de la Lande, Mike Rand, David Story and James Angus and Mrs E Shaw. References to published material are listed below.

[a]Russell KF (1977) *The Melbourne Medical School 1862–1962.* Melbourne: Melbourne University Press, p. 169.
[b]For further details, refer to: Rand MJ. Adventures in autopharmacology: a biographic view with digressions into other matters. *Annu. Rev. Pharmacol. Toxicol.* 1993; **33:** 25–44.
[c]Reid G, Rand MJ. Pharmacological actions of synthetic 5-hydroxytryptamine (serotonin, thrombocytin). *Nature* 1952; **169:** 801–4.

Teaching of Pharmacology at the University of Melbourne

The teaching of pharmacology both to under- and to post-graduate students has naturally evolved over the period 1953–92. Initially, pharmacology was taught only to medical students as part of the physiology course. With the advent of a separate department, the teaching load increased over the years such that pharmacology is now offered to students in the Faculty of Science as part of the science and optometry courses, and is also taught to medical, dental and physiotherapy students, as part of their undergraduate training, in the Faculty of Medicine, Dentistry and Health Sciences.

Unlike the 'Materia medica' course, which was taught to medical students at the University and to pharmacy students at the Victorian College of Pharmacy, and which was concerned with the clinical effects of drugs as well as the efficacy of certain herbal remedies, the teaching of pharmacology has always been concerned with imparting knowledge of the basics of *pharmacology*, the science of the properties and nature of drugs with particular emphasis on their actions. This philosophy of teaching is applied both to medical and to science students.

During Frank Shaw's time as Professor of Pharmacology, many of the lectures and tutorials were given by people from outside the University. Following Mike Rand's ascension to the Chair of Pharmacology, the practice of having outside people give lectures was largely discontinued and the teaching burden fell squarely on the shoulders of those in the Department. Post-graduate research students, then as now, also participated in teaching by conducting tutorials and demonstrating in practical classes as required.

In addition to teaching commitments within the University, staff of the Department of Pharmacology have contributed to the pharmacological education of health professionals in many ways. For example, during the period March 1955 through to February 1956, Frank Shaw published a

series of 12 articles in the *Australasian Journal of Pharmacy* on 'Pharmacology for Pharmacy'. In his introduction to the series Shaw stated:

> *This is the first of a series of articles which tells of the nature of modern pharmacology. In these articles we will relate not only the actions of drugs in the body, not only the use of medicinal substances, but also the mode of action of all these compounds.*[a]

The articles were aimed at improving the knowledge of pharmacists and pharmacy students alike. Among others, topics covered included:

- elementary physiology, in which the CNS, cardiovascular and digestion systems were explained in some depth;
- the administration of drugs, which set out to demonstrate that the principles of dosage were no longer epitomised by the adage 'one teaspoon three times a day', but that a great deal of research had been performed since 1935 to determine the correct manner of administration of drugs, such that an adequate drug concentration could be achieved at the site of action for an adequate period of time; and
- the mode of action of drugs, which explored the cell receptor theory.

Then, in 1967 the first edition of the *Textbook of Pharmacology*, written by W. C. Bowman, M. J. Rand and G. B. West was released onto the market. The book was written by the three in response to their own experiences as teaching staff of the Pharmacology Department of the School of Pharmacy, London. In the preface to the first edition they state:

> *...Each of us thought at the time that he had a clear idea of the kind of book needed by our students. The main problem was that our students needed pharmacology for a variety of reasons. Some became experimental pharmacologists in industry, research institutes and universities and to train these students adequately called for an emphasis on mechanisms of drug action and the theoretical aspects of pharmacology. At the other extreme, some*

students became retail pharmacists and needed a broad view of pharmacology with emphasis on the empirical aspects of therapeutically useful drugs... (W)e hope that (the textbook) will be useful, not only for students of science or pharmacy, but also for medical students and even as general reading for research workers in pharmacology and allied fields.[b]

Since its first release, the textbook has been sold world-wide and is still selling as a basic pharmacology text despite it being last revised some 15 years ago. The second edition, published in 1980, was revised by Bowman and Rand only and is currently also published in Italian and Spanish. It is through publications such as these that the staff of the Department have contributed enormously to the teaching of pharmacology, not only in the University of Melbourne but internationally too.

More recently, staff of the Department of Pharmacology lectured to physiotherapy and nursing students at the Lincoln School of Health Sciences (now part of La Trobe University). In addition, in 1995 the department, in conjunction with the Drug Evaluation Unit at the Austin Hospital, developed a course leading to a Graduate Diploma in Drug Evaluation and Pharmaceutical Sciences.

Faculty of Medicine, Dentistry and Health Science

Medical Course 1953–95

The aim of the Pharmacology course for undergraduate medical students is to provide a sound knowledge of basic pharmacological principles before they embrace clinical pharmacology and therapeutics in their fourth and fifth years. The course is currently geared towards imparting an understanding of the principles of drug action and interaction, thus enabling the development of rational drug treatment in a clinical setting. Although the content of the lecture series may have changed over the years with changes in pharmacological knowledge, the aim of the course has rèmained the same.

Pharmacology was taught to medical students as part of the third year MB BS course from 1953 and consisted of 3 lectures per week in conjunction with a course of 20 practical classes over two terms. Pharmacology was taught to medical students as part of *Physiology Div I* and continued to be so taught until 1975, with no change in either the number of lectures or the number of practical component of the course. In 1975 a separate Pharmacology teaching unit (*Pharmacology 534-031*) was introduced for third year medical students to replace the pharmacology course previously taught as part of *Physiology Div I*. The new pharmacology course consisted of three lectures and one tutorial per week over the entire year, with practical classes and demonstration seminars as scheduled (usually one 3 hour session once a fortnight). The teaching load of pharmacology for undergraduate medical students has not changed since 1975.

In 1953 the Boots Company introduced the first of its sponsored prizes in Pharmacology. The princely sum of £25 was awarded to a third year medical student on the basis of results of the *Physiology Div I* examination. The Boots Prize in Pharmacology continues to be awarded to a third year MB BS student and a list of prize winners can be found in Appendix IV.

Although the format for the teaching of pharmacology to medical students has remained reasonably static over the past 50 years, there have been some changes to the content of the course. In November 1961 a new pharmacology teaching unit, *Div III Applied Pharmacology*, was introduced as part of the medical course. Although the lecture and practical class component was taught to third year medical students, the examination for the subject was to be held during the fourth year of medical studies. *Div III Applied Pharmacology* consisted of a course of 10 lectures on the principles of the actions of common drugs used in medicine, with particular reference to the CNS, circulatory system and anaesthesia. Up until 1975 the syllabus for *Div III Applied Pharmacology* was delivered twice: once on the main campus (for St Vincent's and Royal Melbourne Hospital

students) and once at the Austin Hospital. The first 2 hour *Applied Pharmacology* examination was held in 1962. Over the next 14 years the *Applied Pharmacology* course was expanded to a series of 20 lectures in 1965, 26 lectures in 1968, and 32 lectures in 1974, with practical classes and tutorials being held at the Austin Hospital from 1974 onwards. The course continued to be taught until 1976 when it was taught in conjunction with the Victorian College of Pharmacy and was specifically concerned with the pharmaceutical aspects of drug administration. The following year *Applied Pharmacology* was dropped from the syllabus, as the material it covered was taught again to sixth year medical students as part of the *Materia medica and Therapeutics* course.

In 1973 the UpJohn company awarded the first of its prizes in Clinical Pharmacology and Therapeutics (Div III) to a fourth year medical student. From 1974 onwards the UpJohn prize for Clinical Pharmacology and Therapeutics was awarded to a sixth year, rather than fourth year, medical student and continues to be awarded. A list of prize winners can be found in Appendix IV.

In addition to teaching pharmacology to medical students at the University of Melbourne, in the early 1970s many members of the teaching staff in the Department of Pharmacology were seconded as temporary lecturers in pharmacology in the Department of Human Biology at the University of Papua New Guinea, Port Moresby. Teaching staff were sent to Papua New Guinea at the behest of the then Professor of Medicine at the University of Papua New Guinea, Ian Maddox. Maddox knew Rand from their days together at Sydney University. The course, taught by staff of the Department of Pharmacology, was not intended as a full teaching unit for medical students, but rather, was intended to put effective health workers into the field in Papua New Guinea in the immediate short term. It seems that only staff from the University of Melbourne went to teach Papuan medical students, and those who went included Marian McCulloch, Greg Dusting, Laurie Mashford and Max Fennessy.

Clinical Pharmacology in Australia: The study of clinical pharmacology has traditionally involved the evaluation of new drugs to establish their mode of action in man, their therapeutic efficacy and their toxic effects. In the late 1960s the development of new drugs and their release onto the market was occurring at such a rate that the practice of clinical pharmacology was growing in importance. A 1970 World Health Organization report on clinical pharmacology concluded that in order "to safeguard the individual and public health, an immediate and substantial expansion of clinical pharmacology (was) essential";[c] however, in 1970 only two of the eight Medical Schools in Australia had units of Clinical Pharmacology (located at the Universities of Melbourne, and New South Wales).

The first appointment of a Clinical Pharmacologist in Australia was made jointly by Professors Mike Rand and Austin Doyle, of the Departments of Pharmacology and Medicine, respectively, at the University of Melbourne. In 1969 Laurie Mashford was appointed to the position and was largely based at the Austin Hospital in Heidelberg. In addition to pursuing his own research work as a clinical pharmacologist, Mashford was also responsible for teaching pharmacology to undergraduate medical students. An innovative programme of practical classes for fourth year medical students was devised in order to provide a bridge for the students between information about drugs they received in their lectures and what they were observing to happen in a hospital ward, namely the dispensing of drugs to patients. The practical classes for pharmacology required that students themselves participate by taking a harmless drug, for example an aspirin or a placebo such as lactose, and to make behavioural observations, such as the development of tolerance to pain, at assigned intervals. In the periods between observations, students were given demonstrations of the behavioural and toxic effects of some of the more common therapeutic drugs in animal models. It was felt that students exhibited a greater interest in and understood the relevance of animal model demonstrations as a result of the manner in which these classes were conducted. Indeed, practical

classes held today for medical students are run along similar lines, with students being required to make behavioural and physical observations on fellow students of the effects of drugs such as alcohol, glyceryl trinitrate and β-adrenoceptor antagonists.[d]

In 1970, at a symposium held at the Fourth Annual Meeting of the Australian Society of Clinical and Experimental Pharmacologists, the issue of clinical pharmacology in Australia was further explored.[e] The underlying importance of the discipline was highlighted and the general paucity of teaching of clinical pharmacology in Australasian medical schools was addressed. The symposium called for effective training programmes in clinical pharmacology to be devised and that the contribution that clinical pharmacologists could make to the evaluation of new drugs be more widely promoted. Despite these calls it was not until 1974 that the first Chair of Clinical Pharmacology was established in Australia. With the financial support of Merck Sharpe and Dohme Australia, Professor W. J. Louis was appointed to the Chair at the Austin Hospital, and the University of Melbourne simultaneously created Units of Clinical Pharmacology in all three of its teaching hospitals. Again, this was largely brought about by the efforts of Professors Rand and Doyle.

Department of Pharmacology Summer School: In 1971, the Department of Pharmacology held its first Summer School. The course, organized by Rand and Colin Raper, was designed largely for medics who were working in the pharmaceutical industry. There were two more Summer Schools run by the department, which were organized by Barry Everitt and David Story.

Dental Course 1950–95

Pharmacology was initially introduced to third year dental students as a vague precept in the *Dental Materia Medica and Pharmacology* teaching unit. This unit consisted of a series of 30 lectures that were given to stu-

dents over the course of the year and covered, primarily, the pharmaceutical aspects of drug use. The names and synonyms of pharmaceutical preparations were taught to the students, as were the principles of drug therapy and dosage, routes of drug administration and prescription writing. In 1955, the *Dental Materia Medica and Pharmacology* unit was re-named *Pharmacology and Therapeutics* and was taught as part of the fourth year, rather than of the third year, Dental Science course. The content and format of the lecture series did not change in 1955.

In 1956 the fourth year *Pharmacology and Therapeutics* teaching unit was divided into two distinct sections: Pharmacology and Therapeutics.The Therapeutics section was itself divided into several teaching groups:

- drugs of particular interest to the dentist, such as local anaesthetics, mouthwashes, toothpastes and toothpowders, among others;
- drugs of general interest, which described drugs acting on the respiratory, circulatory, gastrointestinal and renal systems;
- poisoning and its treatment; and
- principles of prescription writing.

Table 2 Syllabus for Pharmacology and Therapeutics, fourth year Dental Science, The University of Melbourne, 1969*

Routes of administration, absorption, distribution, metabolism and excretion of drugs
Selective toxicity and chemotherapy of infections
Drugs affecting clotting mechanisms
Local anaesthetics
Histamine, 5-hydroxytryptamine and polypeptides
Autonomic nervous system: anatomy and function; drugs affecting cholinergic and adrenergic mechanisms
Drugs affecting the neuromuscular system
Drugs used in cardiovascular therapeutics
Drugs affecting the central nervous system: anaesthetics, analgesics etc.
Drug interaction and toxicology

* Information obtained from the Faculty of Dental Science Course Handbook, 1969.

Thus, although the pharmaceutical aspects of drug use that had been covered in the *Dental Materia Medica and Pharmacology* teaching unit were still taught, the principles of pharmacology, such as the mode of action of drugs, was now also being taught to dental students.

The pharmacology course for dental students remained relatively static in terms of the numbers of lectures delivered to students and their content until 1969 when the syllabus was altered dramatically. The lecture series now covered a much more detailed spectrum of pharmacological concepts (see Table 2).

In 1970, the *Pharmacology and Therapeutics* teaching unit was no longer taught to fourth year students, but was instead introduced as part of the third year course again. There was no corresponding change made either to the number of lectures given or to the syllabus itself. The syllabus for third year pharmacology as part of the Dental Science course has not changed greatly since 1970, with the current lecture series covering essentially the same areas of pharmacology as listed in Table 2. However, in 1976 the name of the dental pharmacology teaching unit was changed to *534-039 Pharmacology* and in 1978 the lecture series was increased to cover 40 hours of lectures with 10 hours of associated practical classes and tutorials. Currently the course consists of 44 hours of lectures and 8 hours of associated practical classes and tutorials throughout the entire year.

Pharmacology for Physiotherapy Students, 1993–95

Following the expansion of the Faculty of Medicine and Dentistry to the Faculty of Medicine, Dentistry and Health Sciences in 1990 and the subsequent establishment of a new School of Physiotherapy, pharmacology is now also taught to third year Physiotherapy students. The aim of the pharmacology for physiotherapy course is to give students an understanding of drug mechanisms in general with examples appropriate to physio-

therapy practice and to impart the skills necessary to understand and apply new drug information in their practice of physiotherapy; a similar rationale to that used to determine the course content for optometry students (Faculty of Science).

Faculty of Science

Pharmacology, as a subject, was not offered to science students at the University of Melbourne until 1957. It was then divided into two teaching units, *General Pharmacology*, to be offered to second year BSc students, and *Cell Pharmacology* for third year students.

In 1958, the *General Pharmacology* course was extended to be taught in two parts over two years. The first part of the course, *Pharmacology at Cellular Level*, was concerned with the pharmacology of naturally occurring substances, such as acetylcholine and adrenaline, and the mode of action of certain drugs, including antibiotics. *Pharmacology at Cellular Level* was taught to second year students and consisted of a course of 25 lectures and 48 practical classes. The second part of the *General Pharmacology* course, *Biological Assay*, was concerned with teaching students the general principles of statistics and biological assay and the techniques of biological assay. There were 10 lectures given to third year students as part of this course and 60 hours of practical work in the laboratory.

General Pharmacology, in two parts, and *Cell Pharmacology* continued to be offered to BSc students to take in combination with other subjects as part of the science course until 1966, after which time pharmacology could be taken in third year only as either *Pharmacology A* or *Pharmacology B* (see below).

Table 3a *Pharmacology A* practical class experiments organized for third year BSc students, University of Melbourne, 1962.

Flame spectrophotometry of [Na^+] and [K^+] in toad muscle and plasma
Glucose tolerance using spectrophotometric measurement of blood glucose levels
Analeptics in the toad
Absorption spectrum of ATP
Paper chromatography of leaf pigments
Partition chromatography of barbiturates
Site of curare's action in the toad
Phrenic nerve diaphragm of the rat
Effect of catecholamines in the conscious dog*
Bioassay of prepared digitalis tablets in guinea-pigs
Effect of heparin on clotting time of rabbits
Effect of anticancer drugs on ascites tumours in mice
Histamine aerosol and anaphylaxis in the guinea-pig
Drug action on the cardiovascular system in the anaesthetized cat
Competitive and depolarizing neuromuscular blocking drugs in the anaesthetized cat
Ganglion blocking drugs in the anaesthetized cat
Action of 5-HT in the rat fundus
Effects of drugs on respiration in the anaesthetized cat
Diuretics in the anaesthetized rabbit
Sleeping times
Toad rectus muscle - Bioassay
Straub heart
Unknown - using Straub heart and toad rectus
Bioassay of acetylcholine on ileum

* Demonstration to students.

Table 3b Examples of third year science pharmacology practical class experiments, University of Melbourne, 1995.

Organ bath experiments

Guinea-pig ileum: dose– response curves to acetylcholine, noradrenaline and histamine

Rabbit aortic rings: competitive antagonism between prazosin and noradrenaline

Guinea-pig atria and uterus: demonstration of differences of adrenoceptor subtypes in different tissues by the use of selective β_1- and β_2-adrenoceptor antagonists

Whole animal experiments

Rabbits: investigation of the baroreceptor-heart rate, nasopharyngeal and Bezold Jarisch-like reflex

Rats: investigations into drugs affecting the cardiovascular system

Behavioural screening in mice (video recordings)

Biochemical/pharmacokinetic studies

Radiological binding of [^{125}I]-CYP in rat brain membranes

Alcohol dehydrogenase and protein assays in mouse tissues to determine distribution of alcohol and acetaldehyde dehydrogenase

* Due to the extent of the current practical course for third year science students, only a small representative sample of experiments performed in the practical classes has been listed.

Third year BSc pharmacology

***Pharmacology A* and *Pharmacology B*, 1960–71:** In 1960 a further two teaching units, *Pharmacology A* and *Pharmacology B*, were introduced for BSc students at the University of Melbourne. The lecture content for both was identical and covered biological assay, elementary statistics, the pharmacology and mode of action of the more important drugs of the time and the metabolism and biochemical principles of drug action. The only difference between the two pharmacology units was the extent of the practical component. Students electing to do *Pharmacology A* were required to complete 12 hours of practical classes per week, whilst students choosing to do *Pharmacology B* were only required to attend 6 hours of practical classes per week.

Unlike current practical classes for third year science students that require students to perform experiments that demonstrate and reinforce the principles of pharmacology espoused in their lectures, in the early 1960s practical classes for BSc students consisted of both experiments performed by the students and demonstrations utilizing more difficult techniques, such as the anaesthetised cat and dog preparations (refer to Tables 3a,b). The demonstrations were, more often than not, an extension of work being performed in the laboratory at the time by research members of staff who would be brought into the practical classes to set up the demonstration for the students. Science students undertaking either unit of pharmacology in the early 1960s were thus exposed to a variety of whole animal studies not seen in today's practical classes; a reflection, in part, of the changes in technology and their effect on research methodology.

In addition to performing different types of experiments during practical classes than the students of today, early BSc students undertaking third year pharmacology were also exposed to a variety of methods that today are obsolete, primarily the means by which tissue responses were recorded. From the earliest days recording equipment for practical classes consisted almost exclusively of kymographs, or smoked drums. Although electronic

recording systems, such as the Rikadenki and Grass chart recorders, were used in the practical classes from the mid- to the late-1970s, smoke drums were still being used as late as 1978 to augment the practical class electronic recording systems, which were sometimes inadequate to deal with student class numbers. Today, even those electronic recording systems are being augmented by 'new technology' following the introduction of the MacLab™ recording systems. This combination with computers provides the students with on-line access to multimedia facilities designed to enhance the learning and efficiency of practical experiments.

Pharmacology 1971–95: A major review of the teaching of pharmacology to science students was instigated in the early 1970s. A committee was formed, with members drawn from the Pharmaceutical Industry and other allied industries outside the University, to advise the Department of Pharmacology on what to teach science students. As a result of this review process, the broad based *Pharmacology A* and *Pharmacology B* units were replaced by six specialized units offered to third year science students, including *534-306 Ocular Pharmacology* specifically for undergraduate optometry students (see Table 4). Although some minor changes have been made in the organization of the pharmacology course and its division into various units, the overall structure of the third year science course has remained the same since 1971 (see Table 4). Currently the third year science course offers four units of pharmacology, each consisting of a series of 26 lectures, and four units of associated practical classes, each a total of 78 hours:

- *Principles of Pharmacology* seeks to educate the student about drug-receptor and second messenger systems, as well as introducing the student to the concepts of pharmacokinetics. The lecture course is augmented by a separate practical course that requires students to carry out organ bath, receptor binding and pharmacokinetic experiments.

Table 4 Pharmacology units offered to third year BSc students, University of Melbourne, 1971–95.

Year	Unit	No. Lectures	Hrs Prac.
1971	301 Systematic pharmacology	26	72
	302 Physiologic pharmacology	12	48
	303 Behavioural pharmacology	12	48
	304 Molecular and biochemical	12	48
	305 Applied pharmacology	12	48
	306 Ocular pharmacology	15	12
1977	301 Pharmacology of therapeutic substances	36	54
	302 Autopharmacology	24	96
	303 Molecular pharmacology	12	48
	304 Applied pharmacology and toxicology	9	42
	306 Ocular pharmacology	15	12
1981	301 Molecular pharmacology	12	36
	302 Autopharmacology	20	60
	303 Pharmacokinetics	9	32
	304 Pharmacology of therapeutic substances 1	15	60
	305 Pharmacology of therapeutic substances 2	12	48
	306 Ocular pharmacology*	15	12
	307 Applied pharmacology	12	48**
1984	301 Molecular pharmacology	12	36
	302 Autopharmacology	20	60
	303 Pharmacokinetics	9	32
	304 Pharmacology of therapeutic substances 1	15	60
	305 Pharmacology of therapeutic substances 2	12	48
	306 Ocular pharmacology*	15	12
	307 Toxicology	12	48
1987	301 Molecular pharmacology	12	36
	302 Autopharmacology	20	60
	303 Pharmacokinetics	9	32
	304 Pharmacology of therapeutic substances 1	15	60
	305 Pharmacology of therapeutic substances 2	12	48
	306 Ocular pharmacology*	18	6
	307 Toxicology	12	48
1992	301 Principles of pharmacology	26	78
	302 Autopharmacology	26	78
	303 Pharmacology of therapeutic substances (lectures)	26	—
	304 Pharmacology of therapeutic substances (practical)		78
	305 Toxicology (lectures)	26	
	306 Toxicology (practical)	—	78
	307 Ocular pharmacology*	18	8
1995	301 Principles of pharmacology (lectures)	26	—
	302 Principles of pharmacology (practical)	—	78
	303 Neuropharmacology (lectures)	26	—
	304 Neuropharmacology (practical)	—	78
	305 Pharmacology of therapeutic substances (lectures)	26	—
	306 Pharmacology of therapeutic substances (practical)	—	78
	307 Toxicology (lectures)	26	—
	308 Toxicology (practical)	—	78
	309 Ocular pharmacology*	18	8

* Ocular pharmacology available for optometry students only; pre-requisite for the subject is enrolement in the Optometry course. ** Laboratory project totalling 48 hours.

- *Neuropharmacology* covers the processes of neurochemical transmission and co-transmission, as well as the action of local hormones and autacoids and drug action at sites of neurotransmission. Experiments performed in the associated practical course to reinforce the principles of neuropharmacology include a variety of organ bath, biochemical and neurotransmitter release studies as well as *in vivo* investigations of the chemoreceptor and baroreceptor reflexes in rabbits.

- *Pharmacology of Therapeutic Substances* covers the pharmacological basis of the action of drugs used to treat ailments of the cardiovascular, respiratory and central nervous systems, the gastrointestinal tract and the eye, as well as investigating the potential therapeutic effects of drugs affecting renal function and electrolyte balance. Additionally, this unit of pharmacology seeks to educate students about the mechanisms of drug action in situations of drug abuse and drug dependence. The practical course associated with the lecture series reinforces the lecture content by a series of experiments utilizing organ bath, receptor binding, and biochemical and whole animal *in vivo* techniques.

- *Toxicology* covers the nature of drug and xenobiotic toxicity, as well as specific environmental toxicological problems. The practical *Toxicology* course further illustrates the principles of drug and xenobiotic toxicity by a series of experiments involving the use of biochemical assays, including immunoassay and *in vitro* genotoxicity testing.

The overall aim of the current course offered to third year science students is to introduce students to the concept of a unified study of the interactions between drugs and living systems, with particular emphasis on the mechanisms of drug action. It is expected that the course will provide a sound basis for further, post-graduate studies in either pharmacology or toxicology.

In addition to the aforementioned units of pharmacology, which are available to all third year BSc students, the Department is also responsible for

teaching pharmacology to third year Optometry students (*534-309 Ocular Pharmacology*). The *Ocular Pharmacology* teaching unit consists of a series of 24 lectures and 6 hours of practical classes and seeks to inform optometry students of the mechanisms of action, pharmacokinetics and therapeutic use of drugs, with particular reference to the eye. By the end of the lecture series and practical course, it is expected that students will appreciate the importance of drug action in the eye and in the rest of the body, and will be sensitive to the particular needs of some of their patients who may require specialized therapy.

Second year BSc pharmacology

Following the discontinuation of the *General Pharmacology* course in 1966, there was no unit of pharmacology offered to second year science students until the introduction of *534-201 Pharmacology* in 1981. When it was first established, the course consisted of 32 lectures in second and third terms. At the time of its introduction, *534-201 Pharmacology* was not a prerequisite for any of the third year pharmacology units on offer and did not become so until 1987. The second year pharmacology course was intended as a broad introduction to pharmacology for BSc students, and the lecture series covered such diverse topics as the physiological process for drug action, pharmacokinetics, and the pharmacology of neurotransmission, therapeutic substances, venoms and toxins, and environmental contaminants. Students were also introduced to the pharmacological aspects of nutrition, drug abuse, and the mechanisms of drug dependence.

Pharmacology 201 proved to be an extremely popular subject with undergraduate science students due to its broad and socially relevant lecture series. However, in order to give students a more realistic introduction to the third year units, which place a heavy emphasis on the practical component of the course, a series of practical classes for second year students was introduced in 1992. The practical course, consisting of one 3 hour

session each week, combines experiments in 'human pharmacology', which are conducted along the lines of practical classes for medical students and investigate the pharmacokinetics of ethanol, glyceryl trinitrate and β-adrenoceptor antagonists in student volunteers, with other, more conventional, organ bath studies. The aim of the practical classes is to maintain student interest in pharmacology while demonstrating to them the importance of good experimental technique and preparing them for the more extensive series of practical classes scheduled for third year BSc students.

Post-graduate studies in pharmacology

The quality of the pharmacology science course at the University of Melbourne has always been relatively important to the Department of Pharmacology itself, as the course has taught and trained many students who have gone on to become departmental research and academic staff. The first student to graduate from the University of Melbourne with a PhD in pharmacology was (Professor) Ivan de la Lande in 1958 who undertook his degree through the Department of Physiology. The first student to graduate with a PhD in pharmacology from the Department of Pharmacology was (Professor) Geoff Bentley, also in 1958. Since then there have been over 100 students who have graduated from the University of Melbourne with a PhD in pharmacology and 18 with an MSc degree. A list of the people who have graduated with post-graduate degrees in pharmacology can be found in Appendix III.

Students undertaking post-graduate studies within the Department of Pharmacology are expected to carry out a research project under the supervision of an appropriate member of staff. The research projects offered to students are tailored to suit the needs of the course. For example, departmental staff will devise projects for BSc(Hons) students in which the experimental work can be completed within 9 months. However, students enrolled in either the MSc or PhD course will undertake more in-depth

research programmes and will be encouraged over the 2 to 3 years of their studies to explore interesting ideas that may crop up as a result of their initial experiments. The requirement that post-graduate students undertake a hands-on research project in the department has not changed since post-graduate studies were first offered in the department.

Unlike some other University departments, the Department of Pharmacology has never had any formal lecture series organized for students undertaking a PhD, although attendance at departmental research seminars is obligatory. These students are required to carry out their research project, keep up with other research work in their field of interest by performing regular literature surveys, present regular research seminars and submit a thesis for examination at the end of their course. More recently, the Department of Pharmacology has strictly enforced the requirement that PhD students who are nearing completion of their studies must formally present their work as a 'Thesis Presentation' research seminar to the department.

The structure of the BSc(Hons) and MSc Prelim. courses in the Department of Pharmacology differ to the PhD course in that in the former students are expected to attend a formal lecture series. The content of the lectures given to post-graduate students has evolved over the years and currently seeks to expand on the information presented to third year BSc students as well as to introduce students to new research techniques and concepts, such as the statistical analysis of experimental results and the use of computers and particular software packages. Until recently students were not examined on the content of the lecture series and student appraisal was made on two oral presentation on topics unrelated to the students' own research work, on end-of-year poster presentations, final oral presentations of the students' own research work and on a written report on their research project. Since 1993 the method of assessment for BSc(Hons) and MSc students has been revised by the Faculty of Science. Currently, students are examined on the advanced lecture series, presentation of an oral seminar on a topic unrelated to their own research project,

written examination of a given published paper, and on their thesis. Whereas originally coursework was only a minor component of student assessment, contributing only 10–15% to the final mark, it now comprises 45% of the overall mark.

There have been other changes to post-graduate courses offered by the Department of Pharmacology that have tended to reflect changes in the University requirements for the conferring of post-graduate degrees rather than being initiated by the department itself. For example, until the late 1960s it was mandatory that students at the University of Melbourne learnt a second science language in order to qualify for the BSc degree and students who went on to post-graduate studies were required to learn yet another science language. By 1968 the University no longer required that secondary science languages be studied in order for students to qualify for either basic or post-graduate degrees. Regardless of University requirements, the aims of the post-graduate courses offered by the department are to train students to think. In addition, students will be taught good research technique and will become competent in associated skills, such as computer literacy, the clear presentation and defence of their research work in either a written or oral format and to critically assess the literature.

Student prizes in pharmacology

As for medical students, there were cash prizes awarded to both under- and post-graduate science students that were sponsored by pharmaceutical companies. Third year science students studying pharmacology were eligible for consideration for the Merck Sharp and Dohme (MSD) prize. The first MSD prize in Pharmacology was awarded in 1964. The MSD prize was awarded to the student who had performed best throughout the year, however, in the late 1960s, only those students taking *Pharmacology A*, and not those taking *Pharmacology B*, were eligible for consideration. The MSD prize in Pharmacology continued to be awarded to a third year BSc student until 1990, after which time it was replaced by the 'Third

Year Science Prize in Pharmacology' sponsored by the Department of Pharmacology itself. A list of prize winners can be found in Appendix IV.

Although the Faculty of Science Handbook records the availability of an ICI Post-graduate Fellowship, neither the University of Melbourne nor ICI (Melbourne) have any knowledge of such an award ever being given. The ICI Post-graduate Fellowship was first available in 1958 for one year, with the possibility of extending the scholarship for a further two years. In 1958 the Faculty of Science Handbook listed the prize as being worth £750; in 1966 it was worth $1500, in the early 1970s it was worth $2500 and as late as 1987 it was being awarded at the level of $1800–2300 per year.

Although there is no record other than those that appear in the Faculty Handbooks that such an award was ever bestowed, it is thought that the awards may have been instigated by a former Medical Director of ICI in recognition of the close association between ICI and the Department of Pharmacology. There is no documented evidence to support such a contention.

In addition to student prizes awarded on the basis of examination results, other financial grants are available for post-graduate students within the Department of Pharmacology. Following the tragic death of Dr Iain Medgett in 1987, his family bequeathed a sum of money to the University in order to establish the Iain Medgett Post-graduate Travelling Fund. Money from this bequest is available to post-graduate students to assist them financially to meet the costs of attending and presenting their work at national or international conferences.

Endnotes

Information for this section was obtained from course handbooks published annually by The University of Melbourne, from Mr Ian MacFarlane, from Drs Fred Mitchelson and Charles Proctor and from Professors David Story, Mike Rand and

James Angus. The list of prize winners was supplied by the Finance and Accounting Department of the University of Melbourne. References to published material are listed below.

[a]Shaw FH. Pharmacology for pharmacy. *Aust. J. Pharm.* 1956; monograph.

[b]Bowman WC, Rand MJ, West GB. *Textbook of Pharmacology*. Oxford: Blackwell Scientific Publications, 1968.

[c]World Health Organization. *Clinical Pharmacology: Scope, Organization, Training*. Technical Report No. 446. Geneva: World Health Organization, 1970.

[d]Mashford ML. Teaching practical classes in clinical pharmacology. *Med. J. Aust.* 1971; **2**, 538–40.

[e]Keynote speeches delivered at the symposium entitled *Clinical Pharmacology in Australasia: An appraisal* can be found in the *Med. J. Aust.*, 1971; **2**, 529–40.

Research in the Department of Pharmacology

Early research projects undertaken by staff in the Department of Pharmacology were generally a continuation of the work performed while staff had been part of the Department of Physiology. For many years following the establishment of the new department, strong links remained between Pharmacology and Physiology, including the collaboration of staff between the two departments on certain research projects. These links were extremely important in the development and progress of research projects in the two departments and for the planning of teaching programmes. Many who worked in the Department in its early days remember the common tea room as being the centre for spirited scientific debate. Although it may sound trite by today's standards, the tea room did provide a surrogate forum for the type of discussion currently to be found at formally organized research seminars, symposia and scientific meetings. It must be remembered that at the time of the Department's inception, there was only one forum at which Australian pharmacologists could regularly present their work to an audience of their peers: the Australian and New Zealand Association for the Advancement of Science (ANZAAS). The Australian Physiological and Pharmacological Society (APPS) was not established until 1960 and the Australian Society of Clinical and Experimental Pharmacologists (ASCEP) did not exist before 1967. Furthermore, unlike today where funding structures are in place to provide financial assistance for academics and students to attend scientific meetings within Australia and overseas, travel to scientific conferences prior to the 1970s had to be funded personally and was thus limited. Hence, the links between the Departments of Physiology and Pharmacology, maintained by a common tea room, were extremely important in fostering scientific debate and progress in research projects.

Other changes over the years include those in the focus of research within the Department of Pharmacology. When the Department was first estab-

lished, it was considered feasible to synthesise, research and eventually develop a new drug to commercial use within the University environment. However, by the late 1960s the ethos of research in university departments had changed sufficiently that drug development was considered to be the domain of the pharmaceutical industry; the role of the university was to provide support to the pharmaceutical industry by conducting broad background research ('basic' research as opposed to 'applied' or 'clinical' research) into the mechanisms of drug action (Rand & Mashford 1969). This shift in priorities is interesting given that in the period 1953–63 the Department of Pharmacology had successfully developed and marketed several new drugs (see later).

One aspect that has remained constant in the 40 year history of the Department is the pursuit of sufficient funds to maintain research activity. Money for research has been primarily provided by Government funding bodies, such as the National Health and Medical Research Council. However, there have been other sources of funding that the Department has tapped. The early Department of Pharmacology, under Frank Shaw, had extensive collaborative links with industry. Many Australian companies donated significant sums to the department on a yearly basis to support the departmental research programme. Additionally, overseas drug companies, such as Geigy (Basle), Carter Products (New York) and its subsidiary Wallace Laboratories (New York), invested vast sums of money to support particular research and development programmes. Geigy (Basle) sponsored research work performed by Keith Cairncross in the area of anti-depressants, and Carter and Wallace, in 1962/63, together donated $US17,000 to the department (and offered to synthesise chemicals for Shaw in sufficient quantities in order to enable clinical trials to be conducted) to assist in the development of a new analgesic and other clinically viable compounds. Following the successful development of clinically useful drugs, the Department of Pharmacology was also able to use royalties from the sale of marketed pharmaceuticals in Australia and overseas to fund some of its

research programmes. However, it must be noted that often the amount received as royalties did not come to much. For example, the cheque forwarded to the Department in 1960 from Nicholas Pty Ltd for royalties (1%) on international drug sales of Megobar, Nostinal and Mylomide for the six month period ending December 31, 1959, came to a total of £68/9/3.[a]

Non-pharmaceutical companies were also generous supporters of the research programme in the young Department of Pharmacology, with research fellowships being sponsored by General Motors Holden (1957–58), the Victorian Racing Club (VRC; 1957–58), and Southward Engineering, which supported Maxwell Whisson's cancer research programme in the department by contributing towards his salary while he was on a fellowship in the UK. The VRC, in 1959, also contributed money towards the purchase of a new infra-red spectrophotometer for the department.[a]

More recent liaisons with industry include the sponsorship of extensive research programmes by a variety of research foundations and pharmaceutical companies, including Glaxo (Australia), Servier, Smith Kline Beecham, the Australian Tobacco Research Foundation and the National Heart Foundation.

A list of the academic and research staff in the Department of Pharmacology over the period 1954–95 can be found in Appendix II. A brief description of the main research concerns of the Department over the period 1954–92, with particular emphasis on notable achievements, follows.

Research Directions 1954–63

The first research reports prepared by the Department show that its research work fell into two broad categories: general pharmacology and applied pharmacology (therapeutics). The former was defined as being primarily concerned with the effects of chemical changes in the cellular environment and investigations into the fundamental properties of living

cells. Experiments that fell into this category focused upon investigations of ionic regulation in nerve and muscle tissues and the correlation between ionic content and the metabolic state of muscle tissue. Applied pharmacology, as its name suggests, was concerned with investigations into drugs with particular therapeutic potential.

General Pharmacology

Until more sophisticated research could be conducted into cellular mechanisms circa 1950, transport of ions across cell membranes was thought to be able to be explained by the Donnan concept. That is, ions on either side of a permeable membrane will tend to move towards a state of equilibrium. However, many experimental observations on the movement of ions in skeletal muscle preparations had shown that this was not the case and that the concentration of K^+ is higher in the cell cytoplasm than in the extracellular fluid, while the reverse is true for Na^+.

Experiments performed by staff of the Department of Pharmacology further demonstrated that the maintenance of cellular ionic concentrations was not due to simple passive diffusion along a concentration gradient across the cell membrane (Shaw *et al.* 1956a,b; Simon *et al.* 1957). Although there was some experimental evidence that Na^+ could be extruded across the cell membrane against a concentration gradient, the research group stopped short of proposing the existence of an active transport mechanism as they felt that there was no definitive experimental evidence to support such a hypothesis (Shaw *et al.* 1956b). The research group concerned with research into 'General Pharmacology' within the department continued investigating ionic fluxes and its correlation with metabolic status of muscle tissue over a period of many years.

Methods used by research staff to determine ionic concentrations and metabolic status included chromatography utilizing 'previously unexploited' solvent systems and techniques that made use of radiolabelled tracers, such as ^{131}I-albumin and ^{22}Na, which were becoming more widely

available for medical research following advances made during the Second World War. Often staff were required to build their own equipment in order to carry out their investigations. The first research report submitted by the Department of Pharmacology to the University of Melbourne, described the development of an automatic recording paper scanner to improve the accuracy of results obtained from chromatographic techniques and details of other pieces of equipment made for recording the electrical activity of muscle tissue were described in published papers (Shaw *et al.* 1956a,b; Simon *et al.* 1957). Members of the department were also required to devise their own counting equipment for experiments that made use of radiolabelled tracers and plans were drawn up in the mid-1960s for the development of a fluorescence device with a xenon light source that would enable measurements of ATP in living cells to be made. A prototype was built by David Story, but unfortunately it did not perform up to expectations and the matter was not pursued. In later years, staff members designed and made their own transducers (displacement, pressure and respiration) and electrodes, and this practice persisted well into the 1980s.

The available technology was always the limiting factor for early experiments into general pharmacology, insofar as it dictated the types of experiments that could be performed and hence the type of research questions that could be tackled.

Applied Pharmacology

By 1957 the focus of applied pharmacology research was in the fields of psychopharmacology and the chemotherapy of cancer. By 1961 a separate psychopharmacological research unit had been established under the guidance of Keith Cairncross and Maxwell Whisson, who was directing a group of workers in the development of carcinostatic substances. However, it was the research effort by staff, under the guidance of Shaw and fuelled by his enthusiasm, in the field of excitatory/analeptic agents, which led to the release of several new clinically useful drugs.

Bemegride: Bemegride (ββ methyl ethyl glutarimide) was first developed by Shaw prior to the advent of the Department of Pharmacology at the University of Melbourne. Its stimulant effects were discovered serendipitously by Geoff Bentley who was then a research student investigating the mechansim of action of morphine. Bentley first injected bemegride into dogs that had been anaesthetized with a mixture of morphine and chloroform and was amazed to see these dogs revive quickly as a consequence of the injection.

Further studies by Shaw into the action of bemegride showed that it was capable of reversing the sedation induced by barbiturates, such as pentobarbital, penthiobarbital and allobarbital, in the mouse and dog (Shaw & Mercier 1956) and although bemegride could effectively antagonize respiratory depression produced by these agents, it was not capable of reversing the hypotensive effects of barbiturates in the dog (Shaw & Mercier 1956). Shaw concluded that the action of bemegride was most likely to be at the neuronal level, with bemegride competing with barbiturates for neuronal receptor sites, as bemegride exhibited very little activity outside the central nervous system (Shaw & Mercier 1956).

Bemegride was capable of antagonizing the effects of barbiturates both prophylactically and palliatively, and so the drug was thought to be of some use in the clinical treatment of barbiturate poisoning. Early clinical trials of the drug were conducted in Melbourne by the Departments of Pharmacology (Samuel Gershon and Frank Shaw) and Physiology (Emile M. Trautner) in conjunction with doctors at the Mental Hospital, Sunbury. The results of the trial indicated that bemegride was of use in the clinical treatment of barbiturate poisoning and bemegride was subsequently produced and marketed commercially as 'Megimide'. An entry for Megimide appeared in the *Australian Pharmaceutical Formulary (APF)* in 1955.

Amiphenazole: Initial observations made in the Department of Pharmacology on the action of amiphenazole (2,4-diamino-5-phenylthiazole) in-

dicated that it was a 'morphine antagonist'. The mechanism of action of amiphenazole in antagonising some of the effects of morphine was unknown, but thought not to be due to cholinesterase inhibition as was the case for tacrine (see below; for a review, see Freeman & Dawson 1991). Extensive clinical trials of the drug were performed in conjunction with the Austin Hospital to establish the drug's potential as an antagonist of the depressant effects of morphine given for the relief of pain to patients with terminal carcinoma. In a trial of over 127 patients who were administered a solution containing a mixture of morphine and amiphenazole, the results demonstrated that large amounts of morphine (up to 217 mg morphine per dose, i.m.) could be so administered without the development of respiratory depression, narcosis, depression of the cough reflex or the development of tolerance to morphine. Furthermore, amiphenazole, when co-adminstered with morphine, seemed to produce 'a bright mental outlook' in patients who were otherwise exhibiting varying degrees of depression (McKeogh & Shaw 1956). On the basis of these results amiphenazole continued to be used as an adjunct to morphine analgesia in Melbourne hospitals and elsewhere (Gershon *et al.* 1958) until it was superseded by tacrine, which was relatively more chemically stable and was a more satisfactory respiratory stimulant than amiphenazole.

Further investigations into the pharmacology of amiphenazole in the Department of Pharmacology, circa 1961, indicated that it was also capable of antagonizing the CNS depressant effects of anti-histamines without affecting their therapeutic efficacy. This was borne out by clinical trials and amiphenazole was subsequently co-administered (orally) with anti-histamines in order to antagonize their sedative effects.

Tacrine: Tacrine (tetrahydroaminacrin; THA) was first synthesized in 1945 by Albert and Gledhill. Although currently it has no clear therapeutic use, investigations are well underway into its potential as a treatment for Alzheimer's disease. Shortly after it was first synthesized in 1945, tacrine was found to have several different potentially therapeutic actions, including:

- bacteriostatic activity (Ferguson & Thorne 1946);
- antagonism of the sedative effects of morphine (Shaw & Bentley 1949, 1952);
- potent anti-cholinesterase activity (Shaw & Bentley 1953); and
- an anti-curare effect in man (Gershon & Shaw 1958).

It was the research effort of staff of the Department of Pharmacology at the University of Melbourne that led to the development of tacrine as a clinically useful and used drug. Given that tacrine effectively antagonized the depressant effects of morphine, clinical studies of the drug, as an aid in anaesthesia and as an adjunct to morphine in pain control, were conducted by the Department of Pharmacology in conjunction with medical staff at both the Austin Hospital and Peter MacCallum Clinic. The results demonstrated that when given with morphine, tacrine enabled complete pain control to be achieved by the use of higher doses of morphine than normal be given, and without any manifestation of the usual side-effects, such as respiratory depression and the development of evidence of morphine addiction and tolerance in extreme cases.

Later studies performed in the Department into the effects of tacrine demonstrated that it was also capable of reversing psychoses induced by glycolates in man and animal models (Gershon 1960). The mechanism of action by which tacrine is able to reverse the effects of glycolate psychotomimetic drugs is not well understood even today, although it is believed that this action of tacrine is important for the understanding of Alzheimer's Disease and the subsequent successful development of therapeutic agents for its treatment (for a review, see Freeman & Dawson 1991).

Propionyl atropine methyl nitrate: In the late 1950s Shaw was close to completing his research on a quaternary ammonium ester of atropine, propionyl atropine methyl nitrate (PAMN). His early studies had shown that PAMN had both muscarinic and ganglionic blocking ability. Further studies demonstrated that PAMN was capable of decreasing the volume

and acidity of gastric juice secretion in man and the motility of the alimentary tract (Herman & Shaw 1958). It was thus considered to be of potential as a clinical agent in the treatment of peptic ulcers.

Clinical trials of the drug in 26 patients with peptic ulcers, conducted in conjunction with the Royal Melbourne Hospital, showed that PAMN was able to completely alleviate the symptoms of peptic ulcer without producing any untoward side-effects, such as disturbance of vision and micturition. The only side-effect noted following 19 of a total of 171 administrations of PAMN, was a 'slight' drying of the mouth (Herman & Shaw 1958). Six patients being treated with PAMN were treated over a period of six months, during which time there was no indication of the development of tolerance (Herman & Shaw 1958).

On the basis of the promising results of the preliminary clinical trial, Shaw proceeded to negotiate an agreement with Drug Houses of Australia Ltd (DHA) for the marketing and development rights of therapeutic agents based on PAMN. An agreement was reached whereby Shaw retained the right to negotiate for the marketing and development of the drug PAMN with interested parties and the University of Melbourne would receive half of the royalties from sales of the pharmaceuticals, which would then be transferred to the Department of Pharmacology's Research Fund.

However, to meet the cost of filing world patents in the name of DHA, which DHA was unwilling to fund, Shaw had to provide £1000 from his own pocket. The University agreed that he do so, and further agreed that he should receive, in exchange, a percentage of the University's share of the royalties (40%, with a maximum payment of £500 in any given year) if the drug proved to have successful marketable value.[a] Royalties thus obtained, from the sale of PAMN-pharmaceuticals and other drugs, were used to help fund research programmes within the department.

Research Directions 1965–92

Following the retirement of Shaw as Professor of Pharmacology and the arrival of Rand in the department, the focus of research within the department shifted away from the development of pharmaceuticals towards research into basic pharmacology (Rand & Mashford 1969). Although Rand has attracted many researchers with varied research interests since his arrival, the department itself has become widely reknowned for its strong research into cardiovascular and autonomic pharmacology. Over the period 1972–90, there has been a core of investigators within the department whose work on the modulation of neurotransmission in cardiovascular models has contributed significantly to the understanding of the mechanisms of neuronal function and hypertension. These people included David Story, Marian McCulloch and Henryk Majewski, as well as the numerous postgraduate students who worked with them.

Automodulation of noradrenergic transmission

Prior to 1959, when Burn and Rand first published their hypothesis of the existence of a cholinergic link in noradrenergic transmission, the concept of neurotransmission had remained rather rigid with the notion being that all nerves in the body were either noradrenergic or cholinergic. The publication of the Burn–Rand hypothesis, although subsequently disproven, stimulated research in the field of neurotransmission and relaxed the strict dogma regarding neuronal systems in the body. It was recognized and accepted that there existed a fair degree of variability in the types of transmitters released, that co-transmitters existed and were released from nerve endings and that neurons were themselves subject to change, both during the developmental process and once they had matured. The Department of Pharmacology contributed to the elucidation of the process of automodulation of noradrenergic transmission, whereby transmitter noradrenaline released from neurons can act at prejunctional receptor sites to inhibit further release of neurotransmitter.

Building on research work performed by other workers overseas, which had tentatively suggested that prejunctional α-adrenoceptors existed on noradrenergic nerve terminals and that their activation could inhibit subsequent transmitter noradrenaline release (Farnebo & Hamberger 1971), Rand, largely in collaboration with David Story and Marian McCulloch, undertook an extensive series of experiments in various isolated tissues to investigate factors capable of modulating transmitter release following sympathetic nerve stimulation. It was the then recent availability of [^{3}H]-noradrenaline that made direct measurement of neuronal transmitter release possible for the first time; prior experiments had only been able to measure transmitter release indirectly, that is, they relied on the measurement of tissue responses to sympathetic nerve stimulation. In addition to demonstrating the existence of an autoinhibitory feedback loop in noradrenergic transmisstion (for reviews see Rand *et al.* 1975, 1990), the research group in the Department of Pharmacology, augmented by a number of postgraduate students, went on to investigate and determine the stimulation conditions required for such an inhibitory feedback mechanism to operate (Story *et al.* 1981).

Although there was an extensive debate whether prejunctional α-adrenoceptors existed and were indeed capable of modulating neurotransmitter release (Rand *et al.* 1982a,b; Kalsner 1982a,b), it was generally accepted by the mid-1980s that there was a range of receptors located on the varicosity that, when occupied by agonists, can modulate (i.e. increase or decrease) transmitter release. Whether under physiological conditions these receptors are stimulated by endogenous transmitter(s) is less certain and will vary for the type of synapse and conditions of stimulation. Nevertheless, the concept of prejunctional transmission is important and a target for many therapeutic agents. Similar concepts have now been confirmed for cholinergic, dopaminergic and GABA-ergic systems (Starke 1981; Chesselet 1984; Rand *et al.* 1990).

Further to determining the conditions under which the noradrenergic autoinhibitory feedback loop operated, various postgraduate students and

postdoctoral workers in the department were involved in investigating prejunctional modulation in a more general way. These studies included investigations into the effects of angiotensin II on transmitter release, which indicated that locally generated angiotensin II can facilitate the release of noradrenaline from nerve terminals by acting on specific prejunctional receptors (Story & Ziogas 1987), and studies performed in the anococcygeous muscle into possible modulatory effects of NANC transmitters (see Rand & Li 1995) that subsequently led to the development of the nitric oxide transmitter hypothesis currently under investigation by Rand at RMIT.

Adrenaline, β-adrenoceptors and hypertension

In 1981, Majewski and Rand published an article in which they hypothesized that the anti-hypertensive effect of β-adrenoceptor antagonists was more than likely due to a peripheral mode of action on prejunctional β-adrenoceptors as distinct from any central effects of the drugs. Other workers had previously demonstrated that β_2-adrenoceptors were located prejunctionally and that their activation could facilitate noradrenaline release. Given that these receptors are more likely to be activated by adrenaline rather than neurotransmitter noradrenaline, Majewski and Rand went on to explore the possibility that, in cases of essential hypertension, blood pressure was increased by the facilitation of noradrenaline release brought about by higher levels of circulating adrenaline. In cases of essential hypertension, the higher plasma levels of adrenaline were attributed to an increase in the secretion of adrenaline from the adrenal medulla, as occurs under conditions of stress, which itself is part of the aetiology of essential hypertension.

Initial isolated tissue experiments demonstrated that adrenaline, in concentrations approximating circulating serum levels reached during enhanced adrenomedullary secretion in man, was able to enhance the stimulation induced efflux of noradrenaline (Majewski & Rand 1981). Further experiments also demonstrated that circulating adrenaline was able to be

taken up by the sympathetic nerves, increasing the half-life of adrenaline in the body from approximately 1 minute (in plasma) to 4 hours (in nerves). Furthermore, adrenaline taken up neuronally was then able to be released as a co-transmitter with noradrenaline following neuronal stimulation in signficant quantities for periods of up to 24 hours after initial exposure of tissues to adrenaline (Majewski & Rand 1981; 1984).

In vivo experiments, in which normotensive rats were implanted with slow release adrenaline, demonstrated that untreated rats with adrenaline implants were able to be made hypertensive, while rats with implants that had been treated concomitantly with β-adrenoceptor antagonists failed to exhibit any elevation in blood pressure. Although these results, taken with those obtained by others, strongly suggested that the activation of prejunctional β_2-adrenoceptors by circulating adrenaline increased blood pressure by increasing the release of neuronal noradrenaline in the heart and blood vessels (for a review see Majewski & Rand 1984), the question of how important these events were in the development and maintenance of essential hypertension remained. If the link between stress and hypertension was proven to be significant, then it was felt that there would be many more options available for the development of specific treatment and prophylaxis of essential hypertension. Currently the possibility of an increase in blood pressure produced by circulating adrenaline remains viable, although the question of its relative importance is yet to be answered.

Pharmacology in the Asia-Pacific region

In addition to performing and stimulating pharmacological research within his department that impacted on the pharmacological community worldwide, Rand was also involved in extensive promotion of pharmacology and pharmacologists in the Asia-Pacific region.

In 1973, following a meeting with Per Saugman of Blackwell Scientific Publications, Rand established the journal *Clinical and Experimental Pharmacology and Physiology* (CEPP). The journal, published in Australia,

was to be a forum in which non-European and non-US pharmacologists could publish their work and thus raise the profile of pharmacology outside Europe and the US. Rand was, for many years, the Editor-in-Chief of CEPP and fostered the publication of research papers from many non-English speaking countries. The journal has survived to the present day and is presently expanding with major contributions and invited reviews, particularly from the South-East Asian region.

In addition to founding CEPP, Rand was also responsible for developing strong links for education and research programmes in countries that were pharmacologically disadvantaged. This included bringing out to Australia many PhD students, many of whom were medically qualified, from countries such as Thailand, Indonesia and mainland China. Many of these students subsequently qualified for a PhD degree in Pharmacology and have since returned to their home countries where they hold senior academic positions and are able to train others. In another educational programme, Rand sent many of his own academic staff as temporary lecturers to teach pharmacology to medical students in Papua New Guinea. This has been discussed elsewhere.

Endnotes

[a]Information on royalties from drug sales, and donations to the Department of Pharmacology Research Fund 1957–64, was obtained from University of Melbourne Archives, Record Services, UM312 Registrars Correspondence Series, files 1964/988 and 1960/1182.

Other, un-referenced, information was supplied by Dr Shirley Freeman and Professors Geoff Bentley, David Story and Michael Rand.

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The Past – 1963

I came to the Department of Pharmacology, University of Melbourne, in late 1963, just over a year before Professor Mike Rand accepted the Chair, and only a matter of months before Professor Frank Shaw vacated it. In those days the Department was located in the old Medical School complex, on the corner of Swanston St and Tin Alley. The Physiology Department was nextdoor, and we shared a common tea room. The buildings were very old and close to demolition, and I well remember the day when a fellow PhD student, Fedora Trinker, actually fell through the rotten floor boards in the tea room, thankfully without incurring major (injury). The research laboratory I shared with Fedora Trinker, David Story, Judy Atkinson and Keith Cairncross was in the basement. It was aptly named 'The Dungeon'. Being below ground level there were no windows, just openings in the wall with wire mesh over them, behind which we occasionally found dead possums. The conditions could have been described as less than perfect. Moving equipment into the dungeon was difficult. The Offner 8 channel recorder was large and heavy, and our attempt to manhandle it down the steps resulted in near disaster – it slid all on its own from the top to the bottom. However, David Story, with great skill managed to get it going again. (M. McCulloch, pers. comm., 1995.)

Future directions – Professor J. A. Angus

Extension to the Medical School Building

The following commentary on the imminent changes to the Department of Pharmacology by James Angus was first published in the 1996 edition of *Chiron*, the journal of the University of Melbourne Medical Society, and is reproduced with their kind permission.

The thirty year old promise of the University to provide purpose-built teaching and research facilities for the Department of Pharmacology is now a reality. The triradiate medical school building is to be completed as originally planned and championed by the later Sir Sydney Sunderland. In March

1996, building will commence to complete floors eight and nine on all three wings with a completion date of September 1997 and at a cost of $19.8 million.

The modern re-development of the School of Medicine pre-clinical departments from the early buildings in the north-east corner of the University campus began with the recognition that the south-west corner of the campus should be the setting for the medical school – in close proximity to the Royal Melbourne Hospital. The first department to move was Biochemistry; into new facilities in 1961 made possible by the generosity of Sir Russell Grimwade. Next the Howard Florey Institute for Experimental Physiology and Medicine was commissioned in 1963, funded by government, private, and overseas funds in anticipation of the new medical school being built nearby. The pressure was on to clear the old medical buildings to allow a site for an urgently needed Physical Sciences building. At this time, the Department of Pharmacology was located in the old medical building complex with Physiology. These buildings were in need of demolition with rotten floor boards and laboratories below ground level in 'dungeon-like' conditions. The relocation plans called for a triradiate building for the Anatomy, Pathology, Physiology and Pharmacology Departments to facilitate integration of medical training and research, and for Biochemistry and Microbiology to be located in separate buildings nearby.

Early plans were for eight floors in the triradiate building with Pharmacology housed in the north wing of the seventh floor sharing animal house facilities with Physiology on the north wing of level eight. However, the building was originally designed for a class of 160 medical students in each year. The government of the day recognized the need for more medical graduates and requested the University to provide for 240 medical students per year. This caused further revision of the plans and a short-fall in funds for accommodating Pharmacology on the seventh floor. Microbiology at this time was teaching RMIT students. The top two floors of the new microbiology building were planned specifically for these students. By the time the new building was completed in 1965, RMIT had decided to establish its own facility freeing up the top floors of Microbiology. With the difficulties with the medical building the University needed to find space for Pharmacology and also Ori-

ental Studies on a 'temporary' basis. Instead of giving Professor Rubbo the entire microbiology building on his return from overseas, he found Pharmacology in part of the fifth floor shared with Oriental Studies. Pharmacology continued to be split between half of the top floor of the old pathology and microbiology buildings until Oriental Studies moved out in 1972. Pharmacology has occupied the fifth floor and half of the fourth floor with its animal house on the sixth floor of Microbiology ever since. Space has always been at a premium. With the gracious permission of Physiology, Pharmacology has occupied two practical laboratories on the second floor of the triradiate building and since 1993 occupied three research laboratories on the sixth floor at the invitation of Pathology. In addition, Biochemistry has shared some of its basement space with Pharmacology to allow a synthetic peptide chemistry laboratory to flourish.

With the appointment of Professor Angus to the Chair of Pharmacology in January 1993, the University began planning to complete the triradiate medical building. The original architects of the triradiate building, Mockridge, Stahle and Mitchell, advised that the structure was still sound enough to allow two additional floors to be constructed and to satisfy the building codes of the 1990s. The original brief was to fit out the north wing of level seven and the whole of level eight but construct level nine to shell with plant rooms and lift motor room on the roof – a brief tentatively costed at $11 million.

However, the National Health and Medical Research Council and the University Animal Ethics Committee advised that there was an opportunity to bring the existing animal house facilities in the triradiate building up to world class standard. In addition, the planning group were keen to see the School of Medicine develop a multimedia centre for student computer interactive learning with networked hardware and the latest in audio-visual CD-ROM and video material for all medical students in the pre-clinical departments. Noting that this was a massive construction programme – potentially disruptive over an eighteen month teaching period, the group advised that we should maximise the long-term benefit of the work by keeping two wings of the extension in shell for future fitting out as and when needed – the last expansion possible in this building.

The Plans

In keeping with Sir Sydney Sunderland's original ideal of integration of facilities, the School of Medicine multimedia unit and educational computer facility of over fifty computer stations will be developed in the north wing of the second floor. The existing seventh floor north and west wings (Anatomy animal house) will be completely cleared and shelled for future expansion. The new eighth floor will house Pharmacology on the three wings: in the east wing a teaching facility with laboratories, tutorial rooms and graduate centre; in the west wing teaching staff offices, administration, molecular pharmacology research laboratories and some core research facilities; and in the north wing, toxicology research and the sixty seat Michael J Rand Lecture Theatre. On the ninth floor, the north wing will house cardiovascular research laboratories for Pharmacology. The remaining ninth floor east and west wings will be combined animal house facilities for Anatomy and Pathology (west) and Pharmacology and Physiology (east). On the tenth floor (roof) will be the lift motor rooms and plant.

There will be a complete upgrade of existing lift services and two new lifts in existing shafts with the older shaft left vacant for future use when the seventh floor is completed.

The architects, Stephenson and Turner, have developed an exciting plan for the 'cap' on the medical school with a slightly extended wall line on the eighth floor and sweeping roof line that should look quite spectacular from Grattan Street. The advantages of this extensive building programme are: to give Pharmacology a state of the art facility after more than forty years in shared/temporary accommodation; to restore space to Microbiology which has been in desperate need to find research laboratories since the original design of the building in 1965; to provide adequate animal house facilities for the medical school consistent with the highest standards for the 21st century to ensure that research and teaching standards can be maintained; to develop a multimedia centre for the School of Medicine; and to provide two wings on the seventh floor for future expansion.

The School of Medicine is most grateful to the University Property and Buildings department, especially Mr Don Ewart, and to the architects Mr Richard

Cameron and Mr David Roberts from Stephenson and Turner for their expert assistance in the project to date. The Faculty of Medicine, Dentistry and Health Sciences and central funds from the University have provided the capital.

We all look forward to the completion of the triradiate medical school – to provide an environment for research and teaching in pre-clinical medical science that is second-to-none in Australia and which will take us well into the 21st century.

The promise of providing these first class facilities owes much to the consistent support and unwavering optimism of our recently retired Dean, Professor Graeme Ryan.

New Research Groups

The change in chairman and move of Professor Story and Professor Emeritus Michael Rand, along with many members of their research group, to RMIT has inevitably led to the restructuring of research groups and interests within the department.

New appointments since 1993 have included Dr Tom Cocks, originally from the Baker Medical Research Institute, who now heads a Human Vascular Pharmacology laboratory within the department, and Dr Philip Marley from the Department of Biochemistry and Molecular Biology at the University to head a Cell Signalling laboratory specifically investigating the activity of adrenal chromaffin cells. My own research group at the University of Melbourne includes many ex-Baker scientists, including Drs Michael Lew and Christine Wright, who head analytical pharmacology and *in vivo* cardiovascular pharmacology laboratories, respectively. Furthermore, Glaxo-Wellcome Australia is currently funding a Peptide Chemistry laboratory in the Department of Pharmacology that is under the direction of Dr Roger Murphy.

This new strength in cardiovascular pharmacology and peptide chemistry within the Department of Pharmacology adds to the work already being

performed in the department, particularly in Dr Owen Woodman's laboratory, where a keen interest in ischaemia and reperfusion injury in coronary circulation has developed.

The appointment of new academic research staff has also expanded the research interests within the department and it is important to note the close bond between the teaching and research activities of the department (see later). In 1993, we welcomed Dr Richard Loiacono, from Monash University, as a lecturer in the department; he is also responsible for the CNS laboratory and has an interest in glutamate neuropharmacology. In late 1993, Dr Tony Hughes was appointed to a lectureship after spending 4 years in the Max Planck Institute for Psychiatry in Heidelberg, Germany, where he developed a keen interest in the development of drugs with neurotrophic activity for the treatment of human neurodegenerative diseases, such as Parkinson's disease. In 1995, Dr James Ziogas, a former C. J. Martin Fellow and PhD student of the department, was appointed to a lectureship in the department and to head a Neuropharmacology laboratory with particular interest in neuroeffector transmission and novel angiotensin II receptors. Most recently, Dr Margaret Morris has been appointed Senior Lecturer. Dr Morris comes to us from an equivalent position in the School of Biological Sciences at Deakin University, Geelong, and has extensive research experience in neuropeptide and CNS control of blood pressure.

These new appointments to the research and academic staff build on the existing research interests into molecular pharmacology within the department, headed by a Reader in Pharmacology, Dr Roger Summers. Dr Summers has developed a molecular biological approach to define novel β-adrenoceptors, the β_3-adrenoceptor, to understand their tissue distribution and, importantly, their function. He has recently recruited Dr Bronwyn Evans from the Howard Florey Institute to conduct the molecular biology experiments.

In addition to these new appointments and new directions in research within the Department of Pharmacology, there are many ongoing research projects of long-time members of staff. Dr David Leaver and the Toxicology laboratory continue their collaborative work with St Vincent's Institute of Medical Research and the Grain Research and Development Board; and Dr Peter Molenaar, following a year spent working with Professor Alberto Kaumann in Cambridge on cardiac β-adrenoceptors in heart failure has set up his own research laboratory within the department.

There are two other initiatives that have recently occurred within the department and have impacted upon the research interests of the Department of Pharmacology.

Australian Venom Research Unit (AVRU)

Associate Professor Struan Sutherland was appointed foundation Director of the AVRU in July 1994 after the privatization of CSL and its decision not to continue with venom research. CSL have supported the establishment of the AVRU in the department and have agreed to a long-term loan of equipment. Recently, the Victorian State Government has provided financial support for the unit with a one-off payment in recognition of the 'public interest' role of the unit in providing support for general practitioners, hospital Poison Centres, the Mining and Tourism industries and by raising public awareness of envenomation. Moreover, in addition to the obvious development of antivenoms and venom testing kits, investigation into the venoms of various creatures offers a potential gold-mine with respect to the development of novel pharmacological tools. From an educational viewpoint, Professor Sutherland's unit should be seen as a national resource for the training of under-graduate medical students in the treatment of envenomation. This unit should complement the extensive database on the sequelae and treatment of envenomation that has been established and is maintained by the Museum of Queensland.

My aim is to see this unit establish its 'research' and 'public interest' roles with appropriate funding from the State and Commonwealth Departments of Health. It should offer a national resource and Pacific Rim centre for toxin research, medical education and public awareness of envenomation. The AVRU will be an important unit in the new departmental laboratories on the eighth floor of the triradiate Medical School building.

Biomedical Multimedia Unit (BMU)

The Department of Pharmacology, under Professor David Story's direction recognized the potential for a Maclab-computer interface in practical laboratories to provide students with access to an extensive on-line database. This experience in the new educational value of computers, interactive learning and self-assessment provided a core of expertise to share with other departments. As a result, in January 1995, the University of Melbourne's School of Medicine established a Biomedical Multimedia Unit. Dr Darren Williams, a former postgraduate student from Dr Summer's laboratory, was appointed jointly to a part-time position in the Department of Pharmacology as BMU director in the School of Medicine. He has dual responsibilities to implement multimedia teaching programmes with 18 Macintosh computers in the Pharmacology practical laboratory for the Department of Pharmacology while overseeing the development of the BMU for the School of Medicine. Recent expansion of the unit includes the appointment of two professional officers, one each for the preclinical and clinical departments, and the development of an umbrella structure for the entire faculty. The aim of the BMU is to draw upon the expertise of the six preclinical departments of Medicine to develop tutorials or practical class experiments for student ease of operation and for department testing. The Department of Pharmacology should be proud that it is contributing to the ground-breaking use of computers and multimedia facilities within the Faculty of Medicine. Given the notebook computer slide presentation facilities that are currently being incorporated into

the design of all new lecture theatres, the BMU will next be involved in ensuring that all teaching staff are competent in the use of this technology in place of traditional overheads. Continuing research and development within the BMU will contribute to the streamlining of teaching and learning programmes within the School of Medicine.

Management

Any competent organization is heavily dependent on its management resource. The Department of Pharmacology is indebted to the extraordinary service of Miss Jenny Steen, as purchasing officer, and the Departmental Manager, Mr Ian Macfarlane. The 'team' covers the portfolio of budget, personnel matters, orders, licenses, health and safety control and advisory-panel to the entire department. This balancing act deserves special mention for its dedication to teachers, scientists, students and the University. These unsung heroes are uniquely valued by all who call for support, advice or professional service.

Research Collaborations

The emerging activity of research and development in the Australian Pharmaceutical Industry has quickened recently with Government incentives such as the Factor (f) Scheme, Cooperative Research Centres (CRC), syndicated research and 150% R&D tax concessions. The Department of Pharmacology is in a position to build important collaborative links with industry either on a short contract basis for the development of a specific molecule, or for more long-term, strategic collaboration involving more fundamental research. Of the former, we have in place a number of contracts with AMRAD, Johnson & Johnson, Astra, 3M and Roche, while Glaxo-Wellcome Australia have negotiated two longer contracts with myself and Dr Roger Summers. These industry collaborations are essential for the survival of a pharmacology department in today's climate because:

- They provide important links with companies that can ultimately develop our target discoveries from basic research;
- We learn how the pharmaceutical industry is thinking and what their priorities are;
- Our graduate students learn what the pharmaceutical industry is about, how it operates and potentially whom it recruits; and,
- We benefit from being furnished with important resources and gaining access to early phase drug development.

If Australia is to sustain a viable pharmaceutical research base, we have to provide well trained and informed graduate employees. The earlier the partnership between Industry and University can develop, the better the outcome for all concerned.

Closure of the Biomedical Safety Testing Unit

In December 1994, the Biomedical Safety Testing Unit in the Department of Pharmacology closed after more than 40 years of operation. Initially, the unit was run by K. Shankley (1956–60), Herbert Fearn (1965–68), Jenny Onley and, most recently, by Dr Conrad D'Souza (1988–92). The unit conducted contract pyrogen testing work for hospital pharmacies, pharmaceutical companies and implantable device manufacturers. Although the mainstay of the unit was the rabbit pyrogen test, other toxicity testing was also performed as required.

With the *in vitro* limulus amoebocyte lysate (LAL) test replacing the rabbit assay and many firms developing their own in-house quality testing, the services of the Unit declined sharply in the early 1990s to render the Unit commercially unviable. Financial returns for such a commercial operation should only be a part of the value of such a unit to the department. Research, graduate training and, perhaps, developing novel toxicity tests could be other important reasons for the maintenance of such a unit within the Department of Pharmacology. There may well be good reasons to justify the reopening of the BSTU in the future.

Teaching

In December, 1994 we formally farewelled Dr Catherine Laska, lecturer and co-ordinator for Medicine, after 17 years of teaching in the department. This superb lecturer, was a much lauded teacher with her no-nonsense approach to 200 plus Third year students. Her care for the individual student and attention to educational standards won many accolades in the Medical students 'counter handbook' and a resounding and emotional farewell at her last lecture in 1994. Vale Cathy. Fortunately she continues to help with casual lectures wedged between her family responsibilities.

Dr David Leaver retired early in December 1995 after seven years dedicated service to teaching and research following a major illness earlier in 1995. David was the stalwart for all toxicology teaching and a favourite among the postgraduate students for his care and support. He has been appointed to Senior Research Associate and will continue to contribute to research and some teaching, hopefully for many years to come. His research in phosphine toxicity and PTHrP are major interests that keep David focused and interested.

Since 1993, there have been refinements in the course structure in a number of teaching units.

Science

We are currently moving to make the second year Pharmacology course an introductory course for continuation onto third year subjects. Pharmacology and Toxicology lectures are split into principles of pharmacology, therapeutic agents and drugs of abuse and toxicology. It is designed to challenge students and begin to integrate other second year subjects with pharmacology. As far as practical work is concerned, we take the view that, as pharmacology is a practical science, this unit should be encouraged without hesitation. However, the present constraints of laboratory

space limits the size of practical class to <40 students of the 140 who attend second year lectures. In 1998, with the completion of our new facilities in the medical building, this figure may rise to 70 students. In recognition that those students who only attend lectures may be disadvantaged by not having the practical experience and, thus, a deeper understanding of the subject compared with the students taking both the lecture and practical units, we intend to have separate theory examinations in line with Faculty of Science recommendations.

In third year Science we have developed a new unit of *Analytical Pharmacology* that will be offered for the first time in Semester 2, 1996. The aim of this new teaching unit is to have advanced lectures for a small number of students in the theoretical aspect of drug/ligand receptor interaction. The practical sessions will be problem based, allowing students to develop skills in autoradiography, radioimmunoassay, *in vitro* functional assays and electrophysiological methods.

In second semester 1997 we plan to have two small half units that cover the present 'toxicology' unit. These new units will cover Toxicology, a truncated version of the older full semester course, and Drug Discovery a new unit that embraces medicinal chemistry, drug design, bioassay and the new approaches of drug discovery through combinatorial chemistry. In general, we will endeavour to provide new units that embrace changing student interests, changes in the field of Pharmacology and importantly changes in staff expertise.

Medicine

The Integrated Medical Science course (IMS) for third year students has been replaced this year (1995) with department driven additional workshop/seminars. This gives the students an opportunity to hear from clinically qualified lecturers about the application of pharmacology in therapeutics. It is not intended as an introduction of a further load of informa-

tion but, rather, to fill out the pharmacology course in an interesting and interactive format by giving practical examples of its applicability.

Graduate Diploma in Drug Evaluation and Pharmaceutical Sciences

Together with the Drug Evaluation Unit of the University of Melbourne based at the Austin Hospital, The Department of Pharmacology is responsible for a new graduate diploma in drug evaluation and pharmaceutical sciences. The course is of four semester units covering basic and clinical pharmacology including toxicology, pharmaceutics, systems therapeutics and a unit on regulatory issues including legal, ethical and international aspects. This year, 23 students enrolled, including five from outside Victoria. The lectures are given in the newly equipped Prest Theatre for distance interactive education using centres linked by telephone for overheads and speaker audio-visual presentation. Students in the Sydney studio (and Brisbane) receive the overheads to be used in each lecture prior to the lecture and subsequently receive a complete video copy of the given lecture. There is ample time set aside for student–student and student–lecturer interaction following each formal lecture, however, students enrolled in centres other than Sydney or Melbourne receive the video only.

In the medium-term, the co-ordinators of the Diploma, Associate Professor Laurie Mashford and Dr Albert Frauman, are planning to encourage other Australian universities to join in delivering a national course drawing faculty from all over Australia. Students would be enrolled in their university of choice, with the appropriate academic responsibility resting with each university. The national course would be controlled by a central group with representatives of each participating university.

This diploma arose from a recommendation from the Baume report on the drug evaluation process. The aim is to better equip graduate nurses, postdoctoral scientists, pharmaceutical company employees and Government scientists in the Public Health area in understanding drug evaluation from drug action, toxicology and regulatory affairs perspectives.

The Partnership of Research and Teaching

Having worked for many years in a full-time research position at the Baker Medical Research Institute with little formal teaching commitment, it may be worth giving my present view of the importance of teaching in relation to research. There is no question that the function and working environment of a Research Institute is somewhat different to that of a university department. The Institute should be well equipped and filled with very bright scientists with excellent research track records who tackle difficult, important problems with medium- to longer-term accountability. It will act as a strategic, national resource in a particular discipline. The future life blood of the Institute will depend, to some extent, on its capacity to recruit and train bright students, to send them away, perhaps overseas, and to re-employ some as laboratory heads.

In contrast, an academic department must be more than just a collection of good teachers. Without doubt the good teachers will be able to interact positively with students and will find it an enjoyable and a rewarding vocation. But the ability to teach and inspire good students needs the intellectual curiosity imparted through research. It is in the Honours and Postgraduate PhD programmes that we must guide our students to think for themselves: to ask important, solvable questions and assist them in doing it!

We have to create a teaching-research environment (a playground for the serious scientist) that allows the student the best opportunity to make an important contribution to pharmacology. I believe that the self-discipline, scientific rigour and problem solving that we can instil in students during the practical classes for second and third year Science students are our best chance to attract and inspire those most able to go on to try a higher research degree. With this in mind we have attracted a most generous and able teacher, Mr Victor Iwanov, to run the practical laboratories. Furthermore, at each practical session an academic staff member or full time research fellow leads the students. The practical sessions are challenging.

The new unit of Analytical Pharmacology will draw out the problem solving ability of the students and expose them to some highly technical research equipment.

What happens next? Provided we have the groundwork in place through the science teaching programmes, students should be attracted to high quality research. For the academic staff member, the time available for uninterrupted, quality research is obviously significantly less than for Institute scientists. But it has to be there in any timetable and used as such when available.

Equipment

It is often said that a lack of equipment hampers innovative research. However, often equipment cannot be purchased but must be designed to solve a particular problem. As Charles Kettering said, 'a research problem is not solved by apparatus, it is solved in a man's head....The laboratory is the means by which it is possible to do the solving after the man has the idea clarified in mind'.

Today there are great advances being made in the Department with respect to the efficiency and sensitivity of equipment used for radioreceptor assays, such as the Phospho Imager. Recently, the University purchased a multiwell microphysiometer, Cytosensor', that measures receptor-coupled cellular metabolic activation in isolated cells. This will obviously add to our expertise in analytical pharmacology and offers cutting edge technology in understanding receptor coupling, and concentration-response curves, and will aid our thinking at the molecular level of pharmacology.

What does this mean for our research and teaching environment in the future? This University is clearly saying that it is prepared to support the Department of Pharmacology in its long overdue need of state-of-the-art teaching and research facilities with the expansion of the Medical School. It is also prepared to help equip the laboratories with first class, expensive equipment. In return, our obligation to the University is to teach and in-

spire students at a level of excellence that ensures that we attract the best students to join our research laboratories and, in partnership, solve important problems.

The result will be seen in more intellectually satisfied scientists who will be inspiring teachers at the cutting edge of pharmacological knowledge. The students, on the other hand, will have benefited from rigorous undergraduate training to be better equipped in pharmacological thinking for whatever career they choose. If they choose to work in research they will continue to challenge their supervisor, who will, in turn, be better teachers for it.

Acknowledgements

Many people have contributed significantly to the preparation of this history. I would like to thank them for the time they have spent talking to me about their own experiences in the Department, for the time they have spent chasing up obscure pieces of information, and for their time in reading the draft copies of the manuscript and making helpful suggestions. These people include: Professor James Angus, Professor Geoff Bentley, Dr Cecily Close, Ms Jenni Davison, Professor Ivan de la Lande, Dr Greg Dusting, Dr Shirley Freeman, Dr Marian McCulloch, Dr Fred Mitchelson, Mrs Fanoula Mouratidis, Professor Mike Rand, Ms Jenny Steen, Professor David Story and Dr James Ziogas.

Special thanks to Dr Catherine Laska for her efforts in finding and collating information from the University of Melbourne handbooks and calendars, and for her support throughout this project.

I would also like to thank the University of Melbourne Archives for permission to use archival material which they hold, and the Herald and Weekly Times for permission to reproduce the photograph of Professor Frank Shaw.

Appendix I

Conditions of Appointment, Chair of Pharmacology, University of Melbourne, December 18, 1953

The following has been reproduced from an original held by the University of Melbourne Archives in the collection of RD Wright Papers.

University of Melbourne

Chair of Pharmacology

Conditions of Appointment

Duties: The Professor will be a full-time officer of the University and will be required:

1. To teach, to conduct examinations, and to exercise supervision over the work in his department, in accordance with the Statutes and Regulations of the University and the direction of the Council.

2. To carry out research and to organise and generally stimulate research work amongst the staff and post-graduate students.

Tenure: The Professor shall hold his office subject to the University Acts and the Statutes and Regulations of the University. Attention is particularly directed to Statute no. IX – THE PROFESSORS, to section 1(a) of which has been added (46) Pharmacology.

Should the Professor desire to resign his office, he shall give six months notice of his intention, such notice to terminate on 31st December.

Emoluments: The salary of the Professor will be £2,500 (Australian) per annum, payable monthly.

Special Information

1. The Professor of Pharmacology will be the Head of the new Department of Pharmacology and will be responsible to the Council for the teaching, the organisation of research and the use of the research grant within his department.

2. As the Pharmacology Department will be housed in the Physiology Building of the University, the present Professor of Physiology will be responsible for the administrative control of matters affecting the buildings, the workshops and their staff, and the general running expenses of the two Departments.

3. The Professor of Pharmacology will be a member of the Faculty of Medicine, of the Faculty of Science and of the Professorial Board.

F. H. JOHNSTON

Registrar

18.12.53

Appendix II

Academic and Research Staff, Department of Pharmacology, 1954-95

The following is a list of teaching and research staff who have worked in the Department of Pharmacology, University of Melbourne. In some instances postgraduate students have been included in the list as 'Research Fellows' or 'Research Staff' due to the University's earlier classification of such students.

Name	Postion held
Ahokas, Jorma T	Lecturer, 1982–84.
Allen, Gary Scott	National Heart Foundation Research Assistant, 1969–73.
Angus, James Alexander	Professor , 1993–
Atkinson, Judith	Research Staff, 1967–72.
Baird, Judith	Research Staff, 1970–73.
Barker, Harold	Lecturer in Pharmacy (PT), 1968–72.
Bentley, Geoff	Honorary Senior Research Associate, 1989–92.
Bergamaschi, Cassia	Visiting Associate, 1995–
Briner, P.	NHMRC Research Scholar, 1957–58.
Brown, Malcom	Research Staff, 1970–73.
Bruce, David Woodland	Senior Demonstrator, 1957–62; Lecturer, 1963–67.
Bury, Ross	Research Staff, 1973.
Cairncross, Keith Douglas	Senior Lecturer, 1961–64; Honorary Associate, 1968.
Carroll, Bernard James	Research Staff, 1967.
Chang, Chong Sing Philip	Univ Malaya Fellow, 1963–64; Research Staff, 1965–67.
Chin, K. L.	Research Fellow, 1991–92.
Clark, David Walter John	Senior Tutor, 1974.
Cocks, Tom	Senior NHMRC Research Fellow, 1993–
Crankshaw, David Pilkington	Research Staff, 1967–72.
Czechowicz, Sonia	Research Staff, 1968.
D'Souza, Conrad D	Research Fellow, 1988–94.
Davey, Trevor	Research Staff, 1972–73.
Diamond, John David	Honorary Associate, 1968–69.
Dougan, Donald Frederick Hunder	Senior Demonstrator, 1967–69.
Dusting, Gregory	Research Staff, 1970–73; Senior Research Officer, 1974–75.
Eddie, Graham	Research Officer, 1984.
Evans, Bronwyn	Research Fellow, 1994–

Name	Position held
Everitt, Barry	Research Staff, 1970–73.
Falckh, Patrick	Research Fellow, 1992–94.
Fearn, Herbert John	Biological Testing Officer, 1965–68.
Fennessy, Max Raphael	Senior Demonstrator, 1961–66; Acting Lecturer, 1967; Lecturer, 1968–72; Senior Lecturer, 1973–91.
Filshie, Margaret	Commonwealth Post-graduate Fellow, 1959–60.
Foucart, Sylvain	Visiting Research Fellow, 1988–90.
Fox, Richard	Professional Officer (BMU), 1994–
Freeman, Shirley Estelle (Simon)	Burroughs Wellcome Research Fellow, 1957–58; Univ Melbourne Research Fellow, 1959–60; Senior Lecturer, 1961–64; Acting Head of Department, 1963–64.
Fujiwara, Toshimasa	Visiting Research Fellow, 1993–96.
Gaff, Geoffrey Alan	Research Officer, 1963–68.
Gay, Wan Soon	Research Officer, 1961–62; Demonstrator, 1963–64; Senior Demonstrator, 1965–71; Principal Demonstrator, 1972–73; Principal Tutor, 1974–83; Lecturer, 1984–92.
Genge, Sandra Ann	Research Staff, 1965–68.
Gerkens, John Francis	Research Staff, 1967–72.
Gershon, Samuel	Senior Lecturer, 1954–62.
Giles, Michael	Research Staff, 1970–73.
Glover, Alice Brita	Demonstrator, 1967–69, 1972.
Goldstein, Tamar	Research Staff, 1969.
Harris, George Samuel	Merck Sharp and Dohme Research Fellow in Clinical Pharmacology, 1968–69.
Heimans, Roland Louis Herbert	Research Staff, 1968–72; Senior Demonstrator, 1973.
Heiskanen, Leo	Research Staff, 1973.
Herman, Laura	Senior Demonstrator, 1954–58; Temporary Lecturer, 1959–60.
Ho, Kong-Sun Andrew	Research Fellow, 1963–64.
Holman, Mollie Elizabeth	Senior Demonstrator, 1955.
Hope, Wendy	Research Staff, 1973; Graduate Research Assistant, 1974–77.
Horowitz, John	Research Staff, 1973.
Hrdna, Paul	Visiting Research Fellow, 1987.
Hughes, Richard (Tony)	Lecturer, 1995–
Isaac, Peter Frederick	Research Staff, 1967–71.
Ishac, Eddie	Research Officer, 1986–88.

Name	Position held
Iwanov, Victor	Senior Tutor, 1994–
Jellinek, Peter	Demonstrator, 1970; Research Staff, 1971–73.
Johnstone, Brian	General-Motors Holden Research Fellow, 1957–58; CSIRO Research Scholar, 1956–1960.
Jones, C.R.	Visiting Research Fellow, 1985–87.
Jurevics, Helga	Research Officer, 1972–73.
Kaul, Pushkar Nath	Research Fellow, 1956–60.
Kemp, Barbara	Research Officer, 1994–
Keramidaris, Efthimia	Research Assistant, 1995
Kompa, Andrew	Research Officer, 1993
Kushinsky, Roslyn	Research Officer, 1978.
Lambert, Geoffrey Andrew	Demonstrator, 1970; Research Staff, 1971–73.
Lang, William John	Senior Demonstrator, 1959–63; Senior Lecturer, 1965–73; Reader, 1974–77, 1981.
Laska, Francis	Tutor, 1975–76; Lecturer, 1977–78.
Leaver, David Downer	Senior Lecturer, 1986–95; Senior Research Associate, 1996–
Lederer, Eva	Research Staff, 1968.
Lee, James Ralph	Research Staff, 1969–72. Research Officer, 1973; Senior Research Officer, 1974.
Lew, Michael John	Research Fellow, 1993–
Lew, R	Visiting Research Fellow, 1991.
Li, Chun Guan	Research Officer, 1992.
Lloyd, Helen Llewellyn	Research Officer, 1963–64.
Loiacono, Richard	Lecturer, 1993–
Macfarlane, Ian	Department Manager, 1988–
Mai, Xiang-Hua	Research Officer, 1992–
Majewski, Henryk	Research Fellow, 1983–85; Senior Research Fellow, 1986–90.
Major, Elaine	Biological Services Manager, 1993–
Malta, Errol	Research Staff, 1973.
Marley, Philip	Senior NHMRC Research Fellow, 1993–
Mashford, Maurice Laurence	Reader in Applied Pharmacology, 1969-87. (Jointly appointed with St Vincent's Hospital, Melbourne, 1974–87).
McCulloch, Marian Wyn	Research Officer, 1963–64; Acting Lecturer, 1965–66; Lecturer, 1967–69; Senior Lecturer, 1970–84; Head, Department of Pharmacology, 1982–84.

Name	Position held
McMartin, Lynne	Research Officer, 1993–
Medgett, Iain Charles	Research Assistant, 1978; Research Fellow, 1983–87.
Miller, Calvin	Research Staff, 1973.
Miller, Robert	Research Staff, 1973.
Minatoguchi, Shinya	Visiting Research Fellow, 1989–90.
Mitchelson, Frederick John	Research Fellow, 1963–64.
Molenaar, Peter	Research Officer, 1989–91; RD Wright Fellow, 1992; NHMRC Research Fellow, 1994–
Morgan, P. J.	Victorian Racing Club Fellow, 1957–58; Anti-Cancer Research Fellow, 1959–60.
Morris, Margaret	Senior Lecturer, 1995–
Mrongovius, Robert Ivan	Research Staff, 1968–73.
Muller, Margaret	Research Officer, 1957–58.
Musgrave, Ian F.	Research Officer, 1990–91.
Murphy, Roger	Senior Research Fellow, 1993–
Mylechrane, Ewan	Research Staff, 1969–72.
Ndika, Lawrence	Research Staff, 1969 (Visiting Professor).
Nott, Michael William	Lecturer, 1975–79; Senior Lecturer, 1980–92.
O'Dea, Kevin	Research Staff, 1967.
O'Neil, Jocelyn Nina	Part-time Lecturer, 1965–66; Lecturer, 1967; Senior Lecturer, 1974–75; Senior Associate, 1977–78.
Padanyi, Robert Geza	Tutor 1977–78.
Paddle, Brian Manning	National Heart Foundation, 1961–62; Research Fellow, 1963–64.
Palmer, William Arthur	Senior Technical Officer, 1969–71.
Parker, Margaret Ann	Senior Demonstrator, 1956.
Pavia, Jill	Senior Research Assistant, 1995–
Pearson, Leonie	Research Staff, 1965–72.
Pomeroy, Alan Richard	Research Staff, 1968–72.
Pun, Lan-Queen	Research Staff, 1967–72. (Asthma Foundation Research Assistant, 1968).
Rajanayagam, M. A. Sharmini	Tutor, 1987–88; Research Fellow, 1991–92.
Rand, Michael John	Professor, 1965–92; Professor Emeritus, 1993–
Raper, Colin	Lecturer, 1966–67; Senior Lecturer, 1968–72; Senior Associate, 1973, 1977–78.
Rattray, James Freeman	Research Staff, 1969–73.
Reid, Julieanne	Research Officer, 1988; Senior Research Officer, 1989–92; RD Wright Fellow, 1992.

Name	Position held
Reinhardt, Stefanie Susanne	Research Staff, 1967–68.
Rennie, Anne Lea	Research Officer, 1963–64.
Roberts, Gladwin	Research Staff, 1973.
Roberts, Susan	Research Officer, 1995–
Robertson, Marian	Research Staff, 1973.
Rodriguez, Aurelio Ortiz	Riker Research Fellow, 1965–67.
Ross, John William	Research Staff, 1967–73.
Rump, L. Christian	Visiting Research Fellow, 1985–87.
Rush, Martin Leigh	Research Staff, 1967–73. (National Heart Foundation Research Assistant, 1968–73).
Ryan, Paul	Research Staff, 1973.
Sampson, Richard	Research Staff, 1969.
Sanders, Michael John	Research Fellow, 1961–62.
Sarantos-Laska, Catherine	Tutor, 1977-86; Senior Tutor, 1987-88; Lecturer 1989-94.
Satchell, David Geoffrey	Research Fellow, 1959–66. (NHMRC Research Fellow, 1961-62).
Schechter, Martin	Senior Research Fellow, 1972–73.
Schneider, K	Research Officer, 1986–87.
Scroop, Gary	NHMRC Senior Research Fellow, 1970–72.
Shankley, K. H.	Standards Testing Laboratory, 1956–60.
Shaw, Frank Herbert	Professor, 1954–64.
Shulman, Albert	Research Staff, 1967; Reader, 1969–72.
Shulman, Glenda Maud	Research Staff, 1967–68.
Sin, Yui-on	Graduate Research Assistant, 1974-75.
Smith, Bronwen Jean (Bryant)	Research Officer, 1973–77.
Sobey, Christopher	Research Officer, 1992–93.
Stafford, Ann	Visiting Lecturer (part-time), 1968–71.
Staszewska-Woolley (Barczak), Janina	Research Fellow, 1974-76; Senior Research Fellow, 1977-90; Senior Associate, 1991-92.
Steen, Jenny	Administration, 1978–
Stewart, Alistair G	Research Officer, 1984.
Story, David Frederick	Research Staff, 1969–72; Lecturer, 1973–75; Senior Lecturer, 1976–84; Reader, 1985–89; Associate Professor, 1990–92. Head, Department of Pharmacology, 1985–92.
Summers, Roger James	Senior Lecturer, 1984–87; Reader, 1988– Deputy Head of Department, 1993–95.
Sutherland, Struan	Associate Professor and Director, Australian Venom Research Unit, 1993–

Name	Position held
Sutton, Irene (Lubawski)	Research Staff, 1969; Research Officer, 1984–87.
Taylor, David Alan	Research Officer, 1978.
Thomson, William	Research Staff, 1969–72.
Trinker, Fedora Regina	Research Fellow, 1963–68.
Varma, Bijoy	Riker International Research Fellow, 1968–69; Demonstrator, 1970; Senior Demonstrator, 1971.
Wale, Janet Louise	Demonstrator, 1967–69.
Whyte, Penelope Christina	Research Staff, 1969–71.
Wilson, Jeffrey	University of Melbourne Research Fellow, 1967–68.
Williams, Darren	Lecturer, 1993–
Wong-Dusting, Helen K.	Research Officer, 1984–91.
Woo, Teh Chai	Research Officer, 1959–64.
Woodman, Owen L.	Lecturer, 1988–89; Senior Lecturer, 1990–95; Associate Professor and Deputy Head of Department, 1995–
Wright, Christine	Research Fellow, 1993–
Ziogas, James	Research Officer, 1987–88; NHMRC CJ Martin Fellow, 1992; Lecturer, 1995–

Appendix III

Post-graduate students, Department of Pharmacology, 1954-95

MSc graduates

1964 MW McCulloch
BM Paddle
JTC Woo
1965 WS Gay
1968 GA Gaff
L Pearson
1970 B Tait
1972 JW Ross
WA Thomson
1973 P Whyte
1975 KH Outch
L Roller
TW Davey
S Mohsin
1979 GA Eddie
1985 I Dachlan
D Ngatidjan
1988 JA Stephenson

PhD graduates

1958 IS de la Lande
G Bentley
1964 KD Cairncross
1966 MW McCulloch
1967 PCC Sing
MR Fennessy
DG Satchell
1968 FR Trinker
1970 PF Isaac
1972 JM Atkinson
DP Crankshaw
J Gerkins
DF Story
AR Pomeroy
B Varma
1973 RLH Heimans
LQ Pun
ML Rush
GS Allen
1974 JA Beard
GJ Dusting
BJ Everitt
AB Glover
P Jellinek
GA Lambert
JR Lee
RI Mrongovius
1975 EJ Mylecharane

PhD graduates

1976 MJ Brown
RW Bury
MP Giles
E Malta
GT Roberts

1977 J Freedman
JW Ross

1978 BJ Bryant
W Hope
FJ Laska
M Law
DA Taylor

1979 R Goldie
JD Horowitz
H Majewski
IC Medgett
RC Miller
RG Padanyi

1980 B Finnin
YO Sin
P Songkittiguna

1981 HA Cole-Goodwin
A Latiff
Z Merican
C Sarantos-Laska
OL Woodman

1982 SJ Lewis
M Sunbhanich
L-H Tung
AJM Verberne
H Wong-Dusting

1983 RT Mason

1984 AR Collett
CA Standford-Starr
AG Stewart
PI Alade

1985 E Mills

1986 RE Loiacono
MJ Quinn
A Rose
CD Spence
DC Thompson
J Ziogas

1987 LK Choo
M Nelson
FCB Ong

1988 AG Meehan
P Molenaar
PN Nolan

1989 GP Anderson
I Musgrave
CB Nelson
DG Parkes
JA Svec

1990 P Kabo
A Mian
MA Widodo
X-H Xiao

PhD graduates

1990 MAS Rajanayagam

1991 M Costa
CA D'Souza
A De Luca
CG Li
T Murphy

1992 Z-Y Du
J Elnatan
NV Korszniak

1993 JL Fitzgerald
D Williams

1994 B Kemp
V Paspaliaris
M La
L McMartin

1995 K Naylor
P Pannangpetch

DSc graduate

1967 A Shulman

Appendix IV

Cash prizes in pharmacology

Boots Prize in Pharmacology

The annual Boots Prize in Pharmacology is awarded to a third year MB BS student on the basis of examination results in Pharmacology.

Date of award	Award recipient	Amount
1957		£25
1976	RA Macdonnel	$50
1977	GS Matalanis	$50
1978	VK Karna	$75
1979	SP Smith	$75
1980	J Nagorka	$75
1981	MR Ditchfield	$75
1982	D Kausman	$100
1983	AD Merritt	$50
1983	J Opie	$50
1984	P Hunter	$100
1985	C Depoi	$100
1986	JC Su	$100
1987	P Crowley	$100
1988	S Larkins	$50
1988	A Sapozhnikov	$50
1989	P Salama	$100
1990	R Sultana	$100
1991	D Wilkinson	$100
1992	K Buising	$200
1993	S Seneviratne	$200
1994	APC Ng	$200
1995	C Tam	$200

UpJohn Prize in Clinical Pharmacology

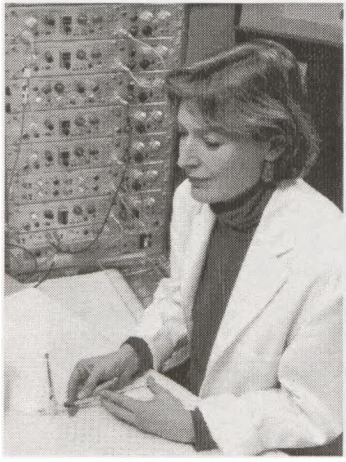
The UpJohn Prize in Clinical Pharmacology was first awarded in 1969 to the final year MB BS student who achieved the highest aggregate marks for the *Therapeutics* section of the medical course. From 1973 the UpJohn Prize has been awarded to a fourth year medical student to coincide with the fourth year course in Applied Pharmacology.

Date of award	Award recipient	Amount ($)
1969	Dr CJ Mullany	50
1970	Dr MM Wolf	50
1971	Mrs M Burbidge	25
1971	EL Green	25
1972	Dr AWF Hamer	25
1972	Dr M De Luise	25
1973	RC Christiansen	25
1973	JD Leslie	25
1974	Dr DJ Handelsman	25
1974	Dr NR Parker	25
1975	Dr KM Nicholls	50
1976	Dr Anne C Powell	50
1977	RH Melville	50
1978	DJ Ames	50
1979	JW Serpell	150
1980	JJ McKendrick	150
1981	J Patrikios	150
1982	M Frydenberg	150
1983	Noel A Cunningham	75
1983	John B Clark	75
1984	PFM Choong	150
1985	N Redgrave	87.50
1985	HMJ Chen	87.50
1986	D Curtis	175
1987	SEP Hauser	175
1988	M Cunningham	175
1989	MJ Butler	175
1990	JM Baird	175
1991	R Gelder	175
1992	J Morton	175
1993	M Krawczyszyn	175
1994	G Hamilton	175

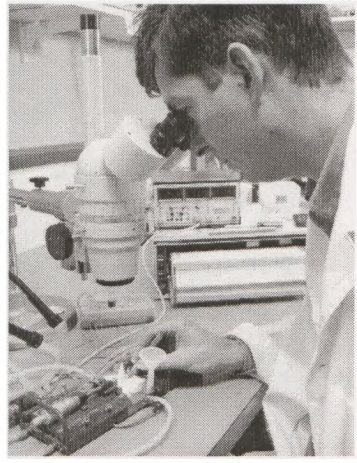
Merck Sharpe & Dohme Prize in Pharmacology

The Merck Shapre & Dohme (MSD) Prize in Pharmacology was awarded annually to a third year BSc student on the basis of results obtained in the Pharmacology examination. After 1990, the MSD Prize in Pharmacology was renamed the Third Year Science Prize in Pharmacology

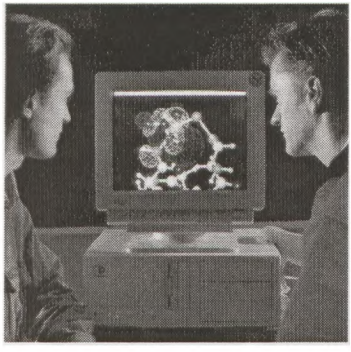
Date of award	Award recipient	Amount ($)
1964	DF Story	50
1965	JR Bassett	100
1966	JW Ross	200
1967	RLH Heimans	200
1968	EJ Mylecharane	200
1969	JF Lenk	200
1970	I Bertonecllo	200
1971	J Milgrom	200
1972	EL Conway	100
1972	M Law	100
1973	C Sarantos	200
1973	RG Padanyi	100
1974	KLH Wong	200
1975	M Nagashima	200
1976	SE Walker	200
1977	R Mason	200
1978	AR Collett	200
1979	AG Stewart	200
1980	RE Loiacono	200
1981	WJ Hum	200
1982	S Hedger	200
1983	FE Sanderson	250
1988	C Ferguson	500
1989	A Riordan	500
1990	HA Buttigieg	500
1991	B Sabangan	100
1992	C D'Abrera	100
1993	B Waldron	100
1994	K Flego	100
1995	S Brennand	100



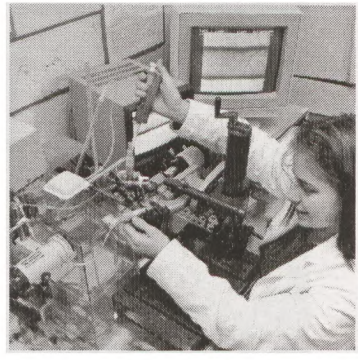
Dr Christine Wright preparing to give an intravenous injection.



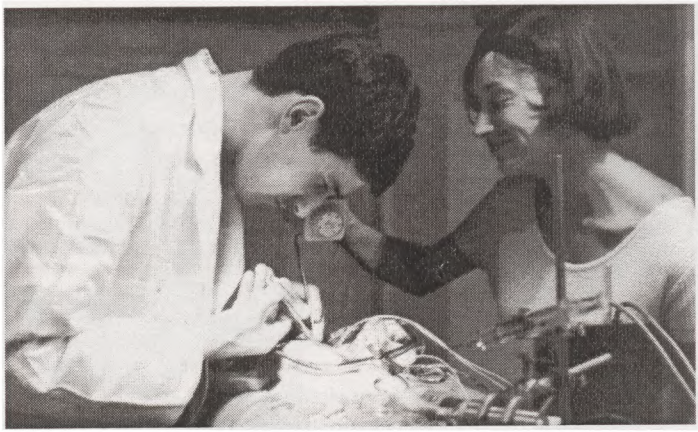
Mr Mark Ross-Smith working with a small vessel myograph.



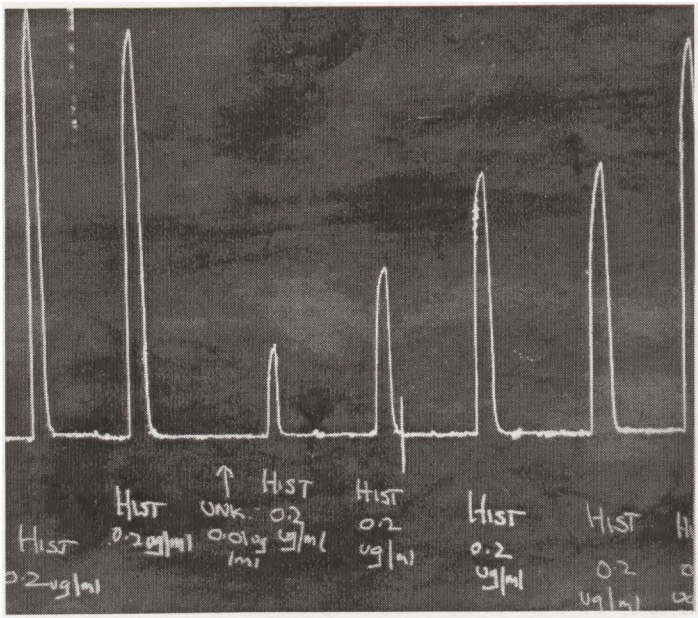
Dr Tony Hughes and PhD Scholar, Mr Paul O'Leary, observing computer generated molecular structures.



Miss Fleur Maffescioni adjusting the apparatus that measures diameter of isolated small blood vessels.



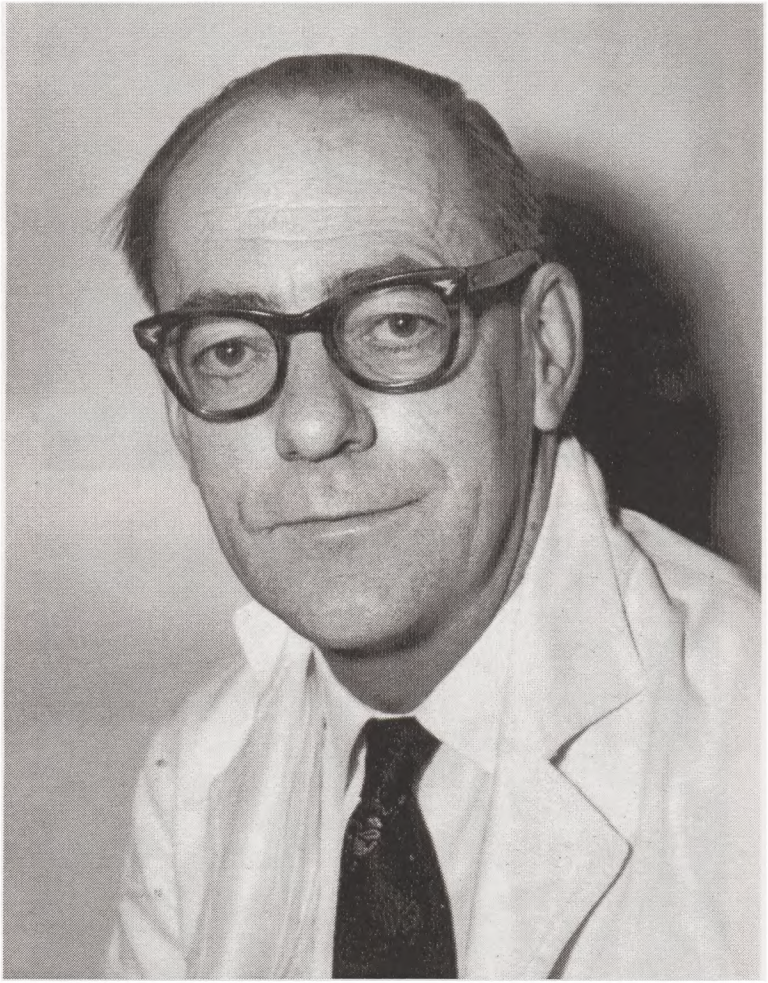
Professor DF Story and Dr J Atkinson working in the laboratory (*ca* 1965).



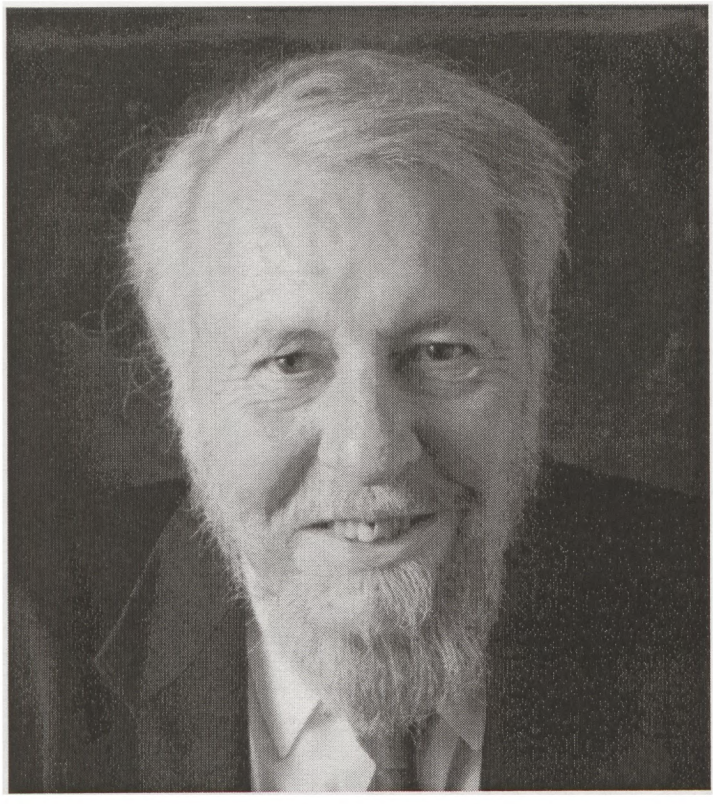
Original kymograph smoked drum traces of contractions of isolated ileum to histamine and in the presence of an unknown drug (UNK) taken in 1968.

Teaching and research staff, Department of Pharmacology, 1988.
Standing (L to R): OL Woodman, M Nott, H Majewski, MAS Rajanayagam, RJ Summers, WS Gay, DD Leaver, MR Fennesy.
Seated (L to R): J Wooley, HK Wong-Dusting, DF Story, MJ Rand, C Laska, JJ Reid.

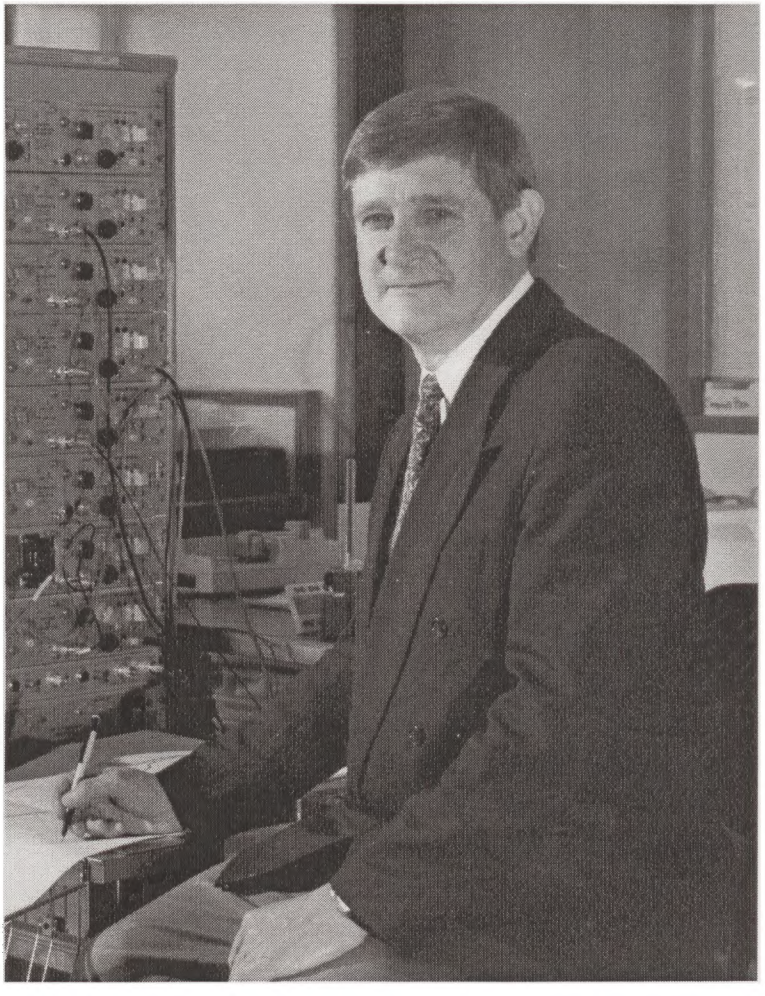
'Lab 1' research group, Department of Pharmacology, *ca* 1990.
Back (L to R): CG Li, H Majewski, XH Xiao, A Lieu, JJ Reid, M Woods, MJ Rand, P Kotsonis, TV Murphy, A Macfarlane, N Hayse, J Condron, DF Story, M Slaughter.
Middle (L to R): S Minatoguchi, N Korszniak, HK Wong-Dusting.
Front (L to R): S Chin, P Vo, K Osbourne, M La, P Thaina, A De Luca, J Fitzgerald.



Professor Frank Herbert Shaw (*ca* 1965).

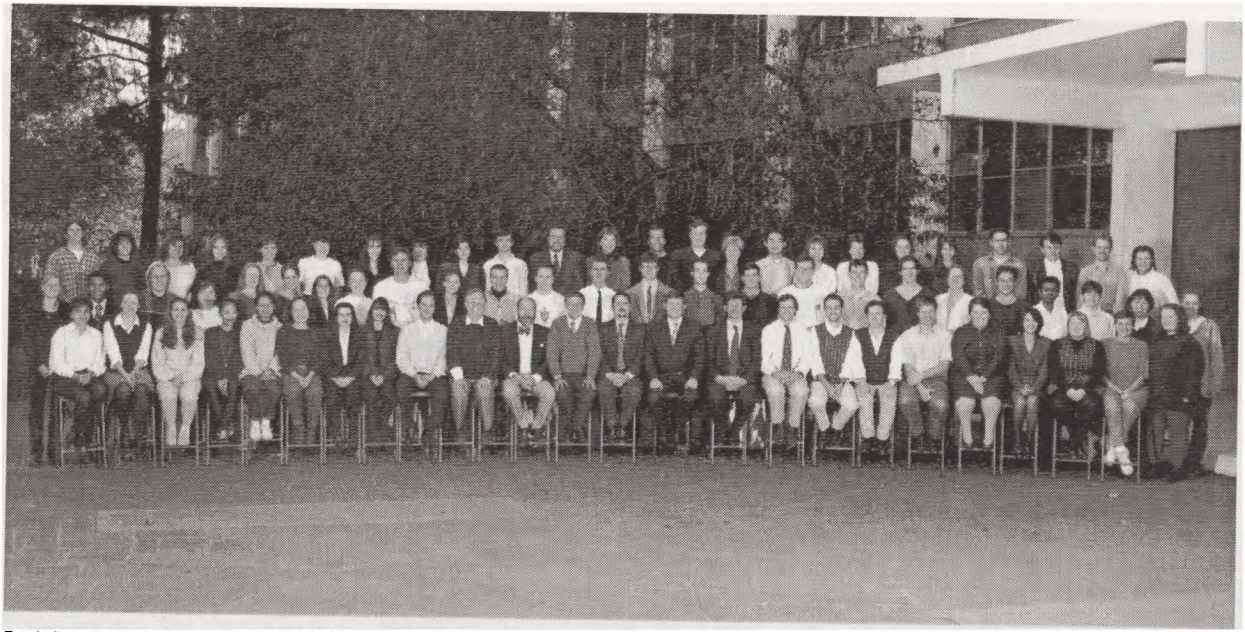


Professor Michael John Rand (*ca* 1992).



Professor James Alexander Angus (*ca* 1996).

Photograph of a model of the extension to the medical school building. The Department of Pharmacology will occupy the eighth and ninth floor.



Back (L to R): L Thompson, C Tortelli, S Cuce, F Maffescioni, V Sozzi, J Hart, S Whorlow, S Flanders, C Bergamaschi, P Coles, R Murphy, C Wright, T Fujiwara, M Lew, B Evans, YY Tan, S Roberts, L McMartin, E Williams, B Kemp, S Selemidis, P Ruggieri, R Fox and K Butcher.
Middle (L to R): M Venn, P Nguyen, S Pannenborg, D Delgado, A Sturman, V Shaw, A Mountain, K Burrell, D Lyons, R Croft, A Serone, J Flinn, T Cocks, P Molenaar, P O'Leary, M Ross-Smith, A Kompa, G Drummond, J Hamilton, C Wiltshire, R Sobon, S Mishra, M O'Farrell, E Keramidaris and J Griffiths.
Front (L to R): M Papaioannou, S Hamilton, D Sarsero, X-H Mai, O Wongsawatkul, K Loke, H Hayes, J Condron, D Williams, D Leaver, S Sutherland, I Macfarlane, O Woodman, J Angus, R Summers, J Ziogas, R Loiacono, R Hughes, V Iwanov, J Steen, F Mouratidis, J Cook, E Major and J Wood.